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USSR Report

MACHINE TOOLS AND METALWORKING EQUIPMENT

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USSR REPORT

Machine Tools and Metalworking Equipment

Contents

METALWORKING INDUSTRY PLAN FIGURES VIEWED

Kiev POD ZNAMENEM LENINIZMA in Russian No 16, Aug 84 pp 48-49

[Article under the rubric "30 September--Machine builders Day: "Overtaking Rates--Facts and Figures"]

[Text] Machine building and metalworking represent the largest and a key sector of our country's economic structure. The development of this sector determines to a decisive extent the further progress of the national economy and the development of all branches of industry, construction, transport and agriculture.

The special role of machine building in switching the economic system to an intensive path of development was emphasized at the 16th CPSU Congress. The accelerated and overtaking development of machine building and metalworking is provided for in the "basic directions of the economic and social development of the USSR for 1981-1985 and for the period up to 1990," approved by the congress. In the 11th 5-year plan the production output of these sectors should grow by at least a factor of 1.4, given an increase in total industrial production of 24 percent.

The machine builders have been given the task of accelerating the development and setting-up of the production of new design machines, equipment, automation equipment and instruments; this will permit large scale use of highly productive as well as energy and material saving technologies, improvement of the technical level and quality of machine building production, and a significant increase in its efficiency, reliability and durability.

The socialist competition of the country's machine builders for implementation of the party's plans has spread widely. Much has been accomplished in the 3 and a half years of the 11th 5-year plan. But in looking back at the path travelled, on the eve of their professional holiday the workers of the machine building sectors are concentrating their attention on the still unsolved problems and

are taking stock of new production reserves which will speed the movement forward to new frontiers.

Today, machine building and metalworking account for roughly 30 percent of all the industrial production of the country. They are ahead of all other branches of industry with respect to the rates of their development. From 1970 to 1983 the total volume of machine building and metalworking production increased by more than threefold. This includes the 11th 5-year plan in which the production increase, compared to 1980, is: 1981--6 percent, 1982--11 percent and 1983--18 percent.

At the present time, Soviet machine building holds second place in the world on the basis of total production volume, and has already been firmly holding first place for a number of years for the output of many types of equipment and machines (metal cutting, lathes, tractors, combines, diesel locomotives, electric locomotives and others).

Machine building and metalworking are characterized by fast paced growth of labor productivity. In these sectors labor productivity increased by more than 2.3-fold from 1970 to 1983. And, compared to 1980, it increased by 5 percent in 1981, by 9 percent in 1982 and by 15 percent in 1983. The machine builders have successfully coped with the plans for increasing labor productivity this year as well.

The quality of the output being produced has risen and its structure improved during the years of the 11th 5-year plan. In this period the output of progressive types of equipment, which ensure the automation of production and a higher technical level of the output manufactured, has increased at rapid rates. Work has continued on developing flexible production systems and new types of highly efficient equipment.

Whereas only 120 automatic manipulators with programmed control (industrial robots) were produced in 1975, in 1980 the figure was 1,579, 1981--3,300, 1982--5,471 and in 1983--10,472. Some 6,800 units were produced in the first half of this year.

Instruments and automation equipment and the spare parts for them valued at 2.8, 4.7, 3.8, 4.1, 4.3 and 2.3 billion rubles were produced, correspondingly, during these years.

The planned volume of production has been achieved and exceeded for other machine building output: metal cutting machine tools and forge and press machinery, petroleum equipment, technological equipment for the light and food industries, freight trucks, tractors, farm machinery, excavators and so forth.

The machine builders of our republic are making a substantial contribution to these achievements.

Today, the machine building and metalworking industries of the republic are a large and highly developed sector responsible for almost all the all-union production volume of special purpose rotor excavators, 97 percent of the

all-union output of main line diesel locomotives, over 52 percent of the main line freight cars, 85 percent of the coke oven equipment, 65 percent of the blast furnace and steel smelting equipment, 37 percent of the rolling equipment, about 50 percent of the power transformers, a large number of the hydraulic and steam turbines, and large electrical machinery.

The machine builders of the republic do much for the solving of the problems of the comprehensive mechanization of production processes in farming, animal husbandry and feed production, and for the technical retooling of other sectors of the agroindustrial complex.

The tractors of the Kharkov Tractor Plant have a good reputation in the country as well as the plows and harrows of the Odessa Plant imeni Oktyabr'skaya Revolyutsia, and the agricultural equipment produced by the Dnepropetrovsk and Ternopol Combine Plants. High ratings have been given to the steam turbines developed and manufactured by the Kharkov Turbine Plant imeni S. M. Kirov, the automatic multispindle lathes of the Kiev Machine Tool Building Production Association, the electronic computing equipment and complexes of the Severodonetsk Impul's scientific-production association and many other industrial products.

The workers increase their production rates from year to year. From 1970 through 1983 the total production volume of the republic's machine building and metalworking industries increased by more than threefold. In the present 5-year plan machine building production has also increased by overtaking rates compared to the production of industry as a whole: by 5 percent in 1981, by 10 percent in 1982, and by 17 percent in 1983 as compared to 1980. These rates were 3, 6 and 10 percent, correspondingly, for industry as a whole.

In 1984 it is planned to increase the volume of machine building production by 5.9 percent. This includes a projected increase of agricultural machinery output for the needs of the agroindustrial complex of 6.4 percent, and an increase of machinery for animal husbandry and feed production of almost 10 percent.

In the first half of this year the production volume of the machine building and metalworking industry increased by 7 percent compared to the corresponding period of last year. The output of metal cutting machine tools increased by 10 percent, and those with numerical control--by 49 percent, industrial robots--by 45 percent, automation equipment--by 8 percent, computer equipment--by 19 percent, chemical equipment--by 10 percent, corn harvesting combines--by 10 percent, and light industry and food industry equipment--by 9 percent.

The machine builders of the republic are successfully fulfilling and exceeding the plans and adopted socialist obligations for increasing labor productivity, while implementing the party's additional target for an above-plan increase of labor productivity and reduction of production costs.

Work on the improvement of production quality is yielding good results. More than a third of the products of the republic's heavy machine building enterprises and more than half of the production of the electrical equipment plants and associations have been awarded the State Emblem of Quality.

An ever increasing number of large complex machines and units of high productivity are being produced in the republic; these include the oxygen converters and rotor excavators with a productivity of more than 5,000 cubic meters per hour produced at the Zhdanov Heavy Machine Building Plant, the diesel locomotives with an 8,000 horsepower capacity produced at the Voroshilovgrad Diesel Locomotive Building Plant and others.

The republic's machine building industry is producing the newest high efficiency technology and equipment not only for internal requirements but for export as well. The rolling mills, excavators, mine lifting machines and ore crushing equipment produced at the Novokramatorsk Machine Building Plant are operating successfully in many countries of the world as are the steam and hydraulic turbines of the Kharkov Turbine Plant imeni S. M. Korov Production Association, the power transformers of the Zaporozhtransformator Production Association, the diesel locomotives of the Voroshilovgrad Diesel Locomotive Building Plant, the special-purpose equipment and complexes of other machine building enterprises of the republic.

Important scientific potential is available to the machine building sectors. It unites dozens of scientific research, planning-design and technological organizations that develop new production technologies and highly productive machinery and equipment, which provide a significant savings. This machinery and equipment includes superpower turbines and generators for atomic electric power plants, the newest rolling equipment, equipment for continuous casting of billets, powder metallurgy equipment, and new highly-productive metalworking equipment.

Synthetic diamonds and various superhard materials, the application of strengthening coatings to technological equipment elements and machine parts, plasma cutting, laser technology and other progressive methods of processing materials are finding ever greater use in the republic's as well as the country's machine building industry.

The multimillion army of machine builders is persistently increasing the yield of the powerful production potential. Their efforts are directed toward the more complete utilization of intensive factors of management, acceleration of scientific-technical progress, and use of advanced experience. Socialist competition for the achievement of the 5-year plan goals ahead of time, an increase of production output, and an improvement of production quality while reducing all types of expenditures has developed on a large scale.

The work of the Dnepropetrovsk Combine Plant's collective for improvement of the average machine shift received high marks at the December (1983) CPSU Central Committee Plenum and at the January (1984) Ukraine Communist Party Central Committee Plenum.

In the Kiev Machine Tool Association P. P. Matviychuk, brigadier of milling machine operators and Ukraine SSR State Prize winner, initiated a competition, approved by the Ukraine Communist Party Central Committee, that has developed extensively under the motto "May each brigade have the highest labor productivity and production quality, and may each brigade member have an exemplary work place."

The workers at the Sumy Machine Building Production Association imeni M. V. Frunze compete under the motto "May production be highly efficient, may capacities be completely used, and may output be of excellent quality."

An initiative of the advanced collectives of Kharkov Oblast is focused on ensuring the implementation of the 5-year plan goals for growth of production volume without increasing the number of workers or the use of basic types of resources; this initiative, approved by the Ukraine Communist Party Central Committee, has spread widely among the Kharkov Oblast machine builders.

The collectives of the Kharkov Turbine Plant, Sumy Machine Building Plant imeni M. V. Frunze, and Dnepropetrovsk Combine Plant production associations achieved high results in meeting socialist obligations; on the basis of the results of the All-Union Socialist Competition for 1983 these collectives were awarded Challenge Red Banners of the CPSU Central Committee, USSR Council of Ministers, All-Union Central Trade Union Council and Komsomol Central Committee.

Examples of selfless creative labor are demonstrated by the leading workers of the All-Union Socialist Competition and winners of USSR State Prizes for 1983: Z. V. Poteshenko, welder of semi-conductor instruments, of the Zaporozhskoye Preobrazovatel' Production Association; V. Ye. Gubenko, winder of electric machine elements, Konotop Krasnyy Metallist Electromechanical Plant; V. I. Revenchuk, brigadier of lathe workers, Nezhin Agricultural Machinery Plant imeni 60th Anniversary of the Great October Socialist Revolution Nezhinptitsemash Production Association; V. D. Trishchenko, brigadier of electric welders, Zhdanovtyazhmash Production Association; L. A. Cherepnina, radio equipment and instrument assembler, Severodonetsk Impul's Scientific Production Association imeni 25th CPSU Congress; R. A. Kashcheyeva, radio equipment and instrument assembler, Kirovograd Radio Products Plant imeni 25th CPSU Congress, and many other workers.

The production successes and inspired labor of these workers arouse the desire in other workers to complete planned goals ahead of time, to make a worthy contribution to the implementation of the tasks for the technical reequipment of the national economy outlined by the party, and to put the economic system on an intensive track.

12525
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INDUSTRY PLANNING AND ECONOMICS

METAL WASTE IN MACHINE TOOL INDUSTRY EXAMINED

Moscow MATERIAL'NO-TEKHNICHESKOYE SNABZHENIYE in Russian No 6, Jun 84 pp 14-19

[Article by L. Zusman, doctor of economic sciences and professor: "Reducing Metal Waste In Machine building"]

[Text] An indispensable condition for the intensive development of the economy is social production's systematic material-saving character. In accordance with this the 26th CPSU Congress determined the minimum limits of basic material resource economy that must be achieved in the 11th Five-Year Plan. The cautious expenditure of metal[1] in machine building and metal working[2] have special significance among them.

As important as technological metal use indicators are, the evaluation of metal demand in construction as well as the operating metal content of machines attract special attention. These three coefficients together present a picture of the total level of metal product utilization both in machine building and in the operating process of its product.

In 1982 the utilization coefficient for rolled metal in specialized fields of machine building and metal working was about 0.71. This was close to the average utilization level for all types of expended metal products. The savings growth for rolled metal planned in comparison to 1975 was not reached and as a consequence the metallurgy industry did not meet its planned output of economical types of metal products. Technological and constructive reserves which machine building had were also not utilized sufficiently.

By the end of the current Five-Year Plan the savings of rolled products in the machine building industry is planned to reach the 18-20 percent range compared to 1980. This includes 5-6 percent by improving the quality and output of economical designs, 1.2-1.4 percent through substitution, 5.9-6.0 percent through introducing progressive technological processes and 5.7-6.0 percent through improved machines and equipment construction. This metal savings must be reached partly through reserves which were not used in the past five-year plan and the rest, through new sources In this regard it is very important to develop an analysis of potential metal-savings capabilities in machine building and in the process of utilizing its products in accordance with the CPSU Central Committee and the USSR Council of Ministers resolution on strengthening the savings regime.

According to the conclusions of Academician A.I. Tselikov, the country casts six-seven million tons more than necessary. This is explained by the fact that the demand for casting before 1891 was not centrally normalized with strict funding and rate setting of the expenses of rolled products. Therefore many machine building enterprises reached great rolled product savings by substituting casting for it. However, on the average castings are 30 percent heavier than welded structures and elements and this led to an increased weight per unit mass of machines and equipment. In our opinion, in order to avoid this the expenditure of all types of metal products without exception should be normalized and the statistical calculations of actual outlay should be organized.

Heavy nonferrous metals are needed in electrotechnical, chemical and other branches of machine building and also instrument-making where their high electric conductivity and corrosion resistance give increased reliability and endurance to machine and equipment components and assemblies, mechanisms and instruments. However, because of the significant cost of mining and enriching, the high electrical production requirements and therefore the relative high cost of nonferrous metals, their use in product construction does not further the task of direct ferrous metal savings. Nonetheless in recent times the demand is dropping thanks to the higher durability of nonferrous metals.

Plastics are taking on great significance. They are used as insulating material instead of nonferrous metals and to a very limited degree in the manufacturing of components and assemblies in machines, mechanisms and instruments that are exposed to the aggravated effects of corrosion. One kilogram of plastic replaces four to five kilograms of rolled ferrous products. The largest demand is from the electrotechnical machine building cable industry where annually more than 150,000 tons of plastic are used in producing automobiles and electrical appliances and approximately 70 tons are used in producing instruments and automation goods. Only 30 percent of the total volume of plastic demand, an extremely insignificant amount, is used to replace ferrous metals in machine building.

Nonferrous castings, a group of rare earth metals and semiconductors are also used as construction materials but their demand volume is insignificant. On the whole, nonferrous metals and other construction materials replace only six percent of ferrous metals whereas cast iron and rolled steel products make up 21 percent by natural weight of all construction materials and replace about 16 percent of ferrous metals (1982).

In the past decade metallurgists have increased the output of economic types of rolled products. Several rolling mills especially designated to produce shaped milled products used in machine building have been put into operation such as the shaft rolling mill in the Dneprovsk Metallurgical Factory imeni Dzerzhinskiy and the curved shape mill at the Magnitogorsk Metallurgical Combine imeni V.I. Lenin. The output of rolled leaf products including the most economical type, the thin-leaf, cold-rolled, 0.5 millimeter thick product, has grown somewhat. In 1982 production increased 13 percent compared to 1980.

A universal girder machine was put into service at the Nizhne-Tagilskiy Metallurgical Combine imeni V.I. Lenin to reduce welded metal structure

production (large beams). Another machine set up at the Orsk-Khalilovsk Metallurgical Combine is able to roll any strip which eliminates the need for the customer to cut out wide leaf.

However, unfortunately machine building doesn't seem ready enough to use these aforementioned forms of metal production. As a result, a new mill for curved shapes is not fully equipped, just as leaf and angle iron as before are used to repair and face wagons. The mill at Orsk-Khalilovsk suffered this same fate.

At the same time we must note that increased metal consumption for machine building hardware is primarily explained by the lack of enough progressive metal product grades. As is known, thin leaf and partially plate rolled products differ from the commercial product by their smaller thickness and are widely used in welded structures. This reduces the weight of the machines and equipment. Despite these advantages the share of rolled leaf products in the total rolled product output is only 41 percent. Machine building enterprises that are well equipped with metal cutting mill stock are not developing enough yield of forge-pressed and stamped products. It is primarily for this reason that they annually plan for a minimal growth in the share of steel leaf and construction of rolled leaf mills is held back.

We should add that metallurgical enterprises often supply commercial and rolled leak products with a design quality that exceeds that ordered. As a result it is necessary to reduce surplus metal or produce heavier machines.

A second choice is fraught with reducing the technical characteristics of products. Therefore as a rule enterprises follow the first choice. But this leads to a major loss of metal as waste. The specific weight of machines is unavoidably increased by using leaf steel of increased thickness

As the USSR TsSU [Central Statistical Administration] notes in reviewing the completion of USSR economic developments for 1983, combines and enterprises of the USSR ferrous metal, energy, heating and transport machine building ministries allowed significant arrears in completing contractual obligations. As a result metal waste increased, as did the specific weight of machines. In our opinion information on the relationship of the volume of metal work to metal products produced is of interest, although this does not reflect the dynamics for lowering construction metal consumption for machines and equipment produced.

According to the VNIPIlom [All-Union Scientific Research and Planning Institute] the amount of metal waste collected and used in machine building and metal work production has been almost constant for the past 15 years. It is approximately 20 percent of the metal products needed (with the exception of 1981-2 when a savings of about two percent was attained). If one adds to this the uncollected wastes and non-recoverable metal losses (for various reasons) during honing, finishing and cutting and also from oxidation, then by our figures,, this number grows to 24 percent which corresponds to metal product use in the 80.6 to 81 percent range.

The existing reserves of metal savings in machine building are associated with eliminating the slowness in putting progressive operational processes into practice. The basic amount of cast iron and rolled steel products to date is

manufactured in sand-clay molds and during their use the mass of analogous casting is 15-25 percent higher than in progressive operating processes. And 20-25 percent of the metal is lost only because of the large allowance for processing. We are slowly introducing such methods of cast iron molding as electric oven smelting of synthetic cast iron rolled products from steel waste and compared to the cupola method this provides almost a 20-25 percent reduction of rolled product mass.

In the current five-year plan we foresee a small advance in the development of forge and press economy as compared to metal cutting (of three or four points) and in equipping it with progressive types of operating equipment. This will allow them to increase forge work and stamping output of more precise sizes which will reduce the amount of shavings during processing in metal cutting mills. Also a growth in the production of rolled molded shape product is planned. All of this must promote mission completion in the metal rolled product sector.

Molded shape organization in machine building factories is very significant. The manufacture of such shapes in miniature component rolled product mills allows a five- to ten-fold increase in labor productivity, a metal savings of up to 30 percent and an increase in product durability.

Machine and equipment design improvement also has major possibilities for reducing metal demand. According to TsSU in the last seven years (1976-1982) rolled product savings in machine building branches annually make up about 1.5-1.8 percent. This is determined by the difference between the actual outlay for the manufacture of products in corresponding years and the outlay calculated from the output of this product according to the previous year's norm. Since the metal use coefficient remains almost constant, one can conclude that the saving is gained basically by improving product construction and also apparently by changing their structure.

In view of the fact that average metal consumption in product manufacturing in the different spheres of machine building is significantly different, a change in average metal consumption in machine building on the whole depends on shifts in the industry's structure. As analysis shows, such shifts promote a reduction in the average level of metal demand by approximately six percent and a savings of approximately six million tons of metal. This economic trend will become more profound by speeding up electrotechnical industries, instrument making and other science-intensive spheres of machine building.

In the process of operating machines and equipment individual metallic elements break down for various reasons and are replaced by others. As a result so-called buffer waste is formed and this is valued in the 12-12.7 million ton range on the whole throughout the national economy. However, about 20-25 percent of this amount of metal is not collected, especially during repair work under field conditions, in backwaters and underground structures and some of it is removed to factory and city dumps. It is worth considering that the replaced elements of machines and equipment to some degree were watched, were exposed to corrosion and lost 7.5 to 9.0 percent of their original weight.

Consequently in collecting on the scale of 12.5-13.2 million tons of this type of buffer waste, the initial weight of the replaced machine and equipment

elements and the metallic parts of other types of basic funds in 1982 was evaluated at 17.2-19.4 million tons.

As a result of eliminating the changed equipment (molds, rollers, stamps etc) more than four million tons of metal was collected in 1982. Losses from abrasion in the operating process is valued at three to five percent. Consequently, for their replacement the original weight of this equipment was 4.2-4.3 million tons.

By eliminating technological equipment and instruments in 1982 428,000 tons of metal were collected. Taking abrasion and the lack of total collection of failed instruments into consideration, its original weight is estimated at 500,000 tons.

Collecting failed, small-value manufactured equipment and routine demand metal property in 1982 yielded 1.8 million tons of metal. Uncollected metal is estimated at 40-50 percent and consequently reproducing this type metal goods requires 3.0-3.6 million tons of metal product.

Thus 24.9-27.8 million tons of machine building metal production in 1982 was used simply for reproducing basic and all-around funds in the national economy. This is 31-35 percent of the total volume of machine building production in all industrial spheres.

Consequently about one-third of the machine building metal production which is being used simply for reproducing goes to guarantee the efficiency of basic and floating funds. The high expense of repair production is brought about primarily by exchanging physically eroded labor devices in an untimely manner and by unsatisfactorily organizing the repair economy. Thus on the average 2.0-2.5 percent of the machines and equipment in machine building and metal working, including 2.2 percent in 1982, become inoperative from decay, wear and tear and natural calamity annually. The basic reason for this is included in what was until recently the prevalent extensive growth of metal working mills and other types of machines and equipment. Therefore only a small part of their output is forthcoming to replace old materials.

The major repair facilities for operating machines are spread over many locations. For example, automotive transport equipment is repaired in almost 2000 enterprises belonging to more than 40 ministries and departments. Agricultural, construction and road machines are repaired at more than 2000 enterprises. If you consider that many of them have a poor technical base, then the expenditure on major machine and equipment repairs during their service period significantly exceeds the cost of producing them. Thus the cost of repairing tractors used in agriculture is approximately 2.5 times more than the cost of manufacturing them. Supporting the work capacity of an escalator used in construction is roughly that many times more expensive than the original price.

The data cited did not consider economic loss caused by machine and equipment idle time during their repair. In the construction and other industries about 20 percent of the equipment was not used from 40-60 days per year for this reason and modern rolling mills annually stand idle for 12-16 percent of the calendar time for repairs.

In small enterprises and workshops the low amount of repairs lowers the original average service life between repeat major repairs for machines. As a result expenses for technical servicing, routine and unplanned repairs increases 20-30 percent. Even in large specialized enterprises repeat major repairs significantly reduce the average service life.

An important reason for having to frequently repair machine and equipment is that nonferrous metals are not used enough in the manufacture of assemblies that are subjected to accelerated wear and tear.

About 40-50 percent of the stock of mills that we have are in non-machine building industries. A large percentage of these mills could be eliminated or turned over to machine building for modernization if repair work were centralized at the firm level and regional repair enterprises were created.

Concentration, specialization and cooperation in machine building is very significant. The existing situation in this relationship cannot be termed satisfactory. For example, centralized, specialized forge and stamp production makes up only three percent and casting and technological production equipping hardly more than four percent. On the one hand this is conditioned by every industrial enterprise's desire to guarantee its own needs by intraplant manufacturing of products used primarily for repair needs. On the other hand it is conditioned by the low production force of specialized enterprises that produce forgings, stampings castings and production equipment and instruments.

In our opinion we should create regional, specialized interindustry organizations to do the major repairs on machinery and equipment and manufacture those repair parts that are not centrally made at large machine building enterprises. This would help reduce expenditures and increase the quality of major repairs, increase the time between repairs, reduce the need for spare parts and also create significant metal savings.

Creating such specialized interindustry repair organizations, equipping them with machinery and developing the necessary insurance supply of spare parts requires a definite amount of time. During this time it is advisable to eliminate repair departments and sections in small, non-machine building enterprises.

The use of metal products and stocks in a rational pattern can serve as an important source of metal savings in machine building. Science has developed the basic methods for such a pattern of materials and several of them are in operation in metallurgical production and machine building.

However, many metallurgical enterprises do not have free areas to carry out the metal lay out. In our opinion the role of enterprises for delivering the USSR Gossnab [State Committee for Material and Technical Supply] system is growing. These enterprises are designated to organize the cutting of leaf and rolled metal in multiple sizes everywhere. This is especially important in regards to relative sizes of unmeasured length rolled products (so-caller bolster) that is furnished by metallurgical enterprises and regulated by GOST [All-Union State Standard]. A significant part of this cannot be used by the consumer and becomes metal waste. It would be a good idea for such enterprises to also do the various types of thermal treatment corresponding to

the needs of small consumers, in this way increasing the use value of metal and guaranteeing metal savings.

Finally, non-standard products and metal waste should be used more in those areas where it will not cause the product's qualitative deterioration. In this regard, the practice of the Kuzbass Main Territorial Directorate is on interest. By its initiative a workshop in Kemerovo that will make foundation articles for the oblast's construction organizations is being built. Putting it into operation will allow more than 30,000 tons of metal waste to be drawn into economic circulation annually.

In metallurgical enterprises steel wastes predominate. In essence this is short gauge rolled products which corresponds to actual standards by all other parameters. At the same time we know that many metal consumers receiving full-size leaf cut it up into many small bars. The Kuzbassmetallosnabsbyt [Metal Supply and Marketing Administration] Combine organized a workshop to pattern wastes from rolled leaf products. Basically the produce sheets for strengthening underground shafts in the Kuznets coal basin.

The interindustrial character of USSR Gossnab territorial agencies allows them to take measures to intelligently use wastes in combines and enterprises regardless of what department they belong to. Kuzbassmetallosnabsbyt specialists found 13,000 tons of scraps of a steel which is in short supply at only two Novokoznetsk enterprises. After the appropriate preparation this was used for various products. The Kuzbasskhimsbyt [Chemical Marketing Administration] helped save 16,000 meters of steel pipe after noticing their polyamide.

The Kemerovo Oblast's Stroydetal Factory plans a centralized pattern section of rolled products for electrotechnical industry enterprises. According to specialists' calculations the use of computer technology and economic mathematical methods will bring an annual savings of up to 2000 tons of rolled band. In Minsk the Belorussian SSR Gossnab build and put into operation a workshop for patterning and finishing rolled products with a 40,000 ton annual yield. This experience shows that there are major possibilities for supplying and marketing metal saving organizations.

Accomplishing the proposed measures for reducing metal needs in machine building will undoubtedly require significant capital and a definite time that will exceed the current five-year plan. And it is very important to develop specific intra- and interindustry planned solutions now that are aimed at saving metal in this important industry of the national economy.

1. Rolled products, pipes, hardware, four-component alloy products, cast iron and steel castings are considered metals.
2. Machine building and metal working are considered in all spheres of the national economy and henceforth are termed "machine building"

12511
CSO: 1823/82

METAL-CUTTING AND METAL-FORMING MACHINE TOOLS

UDC 658.387.62

NEW CNC TURNING CENTERS DESCRIBED

Moscow MASHINOSTROITEL' in Russian No 8, Aug 84 pp 5-6

[Article by V. N. Rodionov: "On True Way"]

[Text] In recent years, the Srednevolzhsk Machine Tool Building Plant, one of the oldest enterprises in the country, rebuilt its production facilities for manufacturing new progressive equipment -- NC machine tools. A comprehensive program system developed at the plant preserves its specialization as follows: manufacture of especially high precision lathes, turning, chuck-centering and chuck NC machine tools; automatic lathes; semiautomatic threading of lathes; relieving lathes and special equipment. The plant makes 12 basic models, including three NC models whose output is 54 percent of the total volume of production.

Work is being done according to the program on improving series produced machine tools models 16816T1 and KT141 and on the design and organization of the production of robotized technological processes. According to the program, NC machine tools have practically displaced universal machine tools. Two basic models are used as a basis: model 1716PF3 semiautomatic chuck-centering lathe with a maximum diameter of the machined product above the carriage 160 mm (200 mm in a chuck) and semiautomatic model KT141P chuck lathe. These machine tools were exhibited at the "Metalloobrabotka-84" International exhibition in Moscow.

The KT141P machine tool is designed to do various turning work in the semiautomatic cycle, including turning and boring cylindrical, conical and curvilinear surfaces, single-start and multiple-start threading and center drilling holes. Machining is done in chucks or other special fixtures. The high power and tool availability per productive unit, wide range of spindle and carriage speeds, great rigidity and vibration resistance, precision parameters of the machine tool maintained for long periods -- all these make it possible to machine complicated parts in the rough, as well as in the finish modes, including power and high speed cutting with tools made with metal-ceramic and hard alloy inserts; and parts which require very great precision and surface smoothness. The convenient location of controls; automation of basic and most auxiliary operations; good access to the working zone and devices, serviced in the process of operation; use of standard cutting tools; and availability of necessary interlocks make the work on the machine tools efficient and safe.

The machine tool is equipped with CNC which makes it possible to introduce control programs from punched tape or directly from the NC panel. This makes it possible to edit the introduced program and correct the speeds of the carriages during the machining program.

The model 1716PF3 machine tool design includes features that make it possible to maintain at a high technical standard for a long time without radical changes. It should be stressed that each of the basic models permits the following modifications: a lathe complex with a manipulator; a module for turning shafts and flanges; and a semiautomatic lathe for multipurpose machining of parts.

The question of product quality was raised in connection with the changeover to the manufacture of modern high productivity machines and increasing production rates. Eight years ago, a movement originated at the plant to "Guarantee product quality from the plant to the product." This was preceded by the creation of a comprehensive quality control system, development of standards to regulate product requirements at various stages of design, preparation for production, manufacturing and operating machine tools at the customer's facilities including problems of incentives to workers, engineers and technicians for achieving high quality work. This initiative made it possible to attract the entire plant collective to work actively to raise quality especially, workers engineers and technicians involved in designing and manufacturing machine tools, which united mutual responsibility for this or another model of a machine tool.

The first technological chain was created by using the machine shop to manufacture model 1A616F352 NC lathe. Workers of the main designer and main technologist departments, and collectives of forge-blank preparation, mechanical and assembly sections, involved in the design and manufacture of this lathe, concluded a contract of socialist competition, whose goal became the preparation of the lathe for the certification of the State Emblem of Quality. This technological chain consisted of five links and 64 persons participated in it. Principles of mutual help and business cooperation at all stages of lathe manufacture from design to assembly were at the basis of the competition.

At present, there are nine technological chains at the plant.

Social competition under the slogan "Guarantee of quality from design to the product" played a considerable role in improving the operation indicators at the plant. Quality coefficient and the amount of products passed on first presentation increased and labor-intensiveness of the manufactured products and metal consumption of several lathe models decreased.

Another very important direction in the activity of the collective of the enterprise is the reequipment of the plant to create an optimal production structure, efficient arrangement of shops and sections, the introduction of modern equipment and technological processes and improvement in labor conditions. NC lathes acquire special importance in this. The plant already has over 60 such lathes with a third of them being manufactured at the plant.

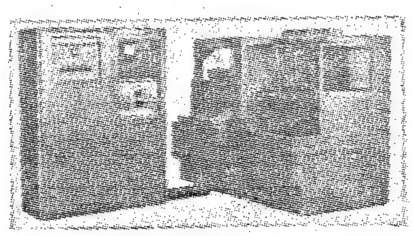
This is especially important because plant specialists, who observe them in operation, take into account obtained data in designing new lathes.

The plant structure changed radically. While previously machine assembly subdivisions did about 80 percent of the work, the basic labor now done by electronics and electrical wiring people. Two new subdivisions were organized at the plant to manufacture electrical equipment and adjust NC systems. They have skilled cadres of electronic engineers and electrical wiremen. The number of such workers increased by 100 and the number of assembly mechanics, lathe operators and auxiliary workers decreased correspondingly in the three years of the 11th Five-Year Plan period. The same trends are also planned for the future; therefore, corresponding corrections were made in the cadre training system.

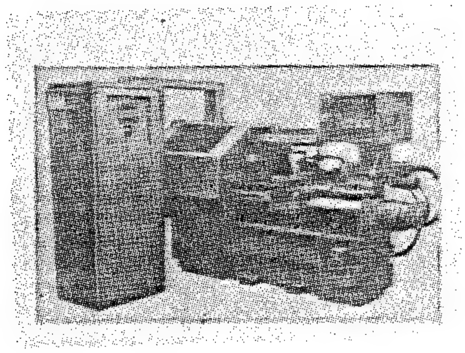
Plane specialists cooperate closely and fruitfully with scientists of the Kuybyshev Polytechnical Institute imeni V. V. Kuybyshev. The scientists help plant specialists raise the technical characteristics of the lathes, improve the technology of their manufacture, solve problems of increasing the accuracy of part machining, and introduce new cutting tools made of superhard synthetic materials.

Preparations are being made at the plant for the introduction of automatic complexes that would make it possible to achieve unmanned technology. Such complexes will consist of NC lathes, robots to load and unload parts, and warehouses for intermediate and finished products. Computer control will make it possible to reduce manual labor in these operations. The introduction of flexible technological lines in machine assembly at the plant make it possible to readjust them rapidly for machining various parts; universal assembly equipment is used widely.

The Srednevolzhsk Machine Tool Building Plant collective is faced by great problems and it does everything necessary to keep in step with technological progress. This is confirmed by today's achievements of the enterprise and the great and complicated problems faced by the collective in the 11th Five-Year Plan period.



Model KT141P NC Lathe



Model 16816T1 NC lathe

2291
CSO: 1823/77

METAL-CUTTING AND METAL-FORMING MACHINE TOOLS

UDC 621.65.011.56:621.9

LARGE CNC MACHINING CENTER FOR TURBINE PRODUCTION

Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 6, Jun 84 pp 1-2

[Article by A. G. Nepryakhin, engineer: "Model NS-33F2 NC Metal Machining Center"]

[Text] The 16th party congress outlined ways to develop power in our country, paying special attention to an increase in the unit power of power installations and a wide development of the nuclear electric power plant network.

The constantly increasing requirements of electrical power forces builders of power complexes to increase capacities more and more. Today, 800 megawatt turbines are being built and prototypes of 100 to 1250 megawatt installations were produced. Designers are thinking about still greater capacities.

A new and complicated problem in the process of this development was also posed for machine tool builders.

The Novosibirsk "Tyazhstankogidropress" Machine Tool Building Association developed a CNC planer machining center (see Fig.) for machining large high precision parts equipped with necessary tools, metals and quality control devices.

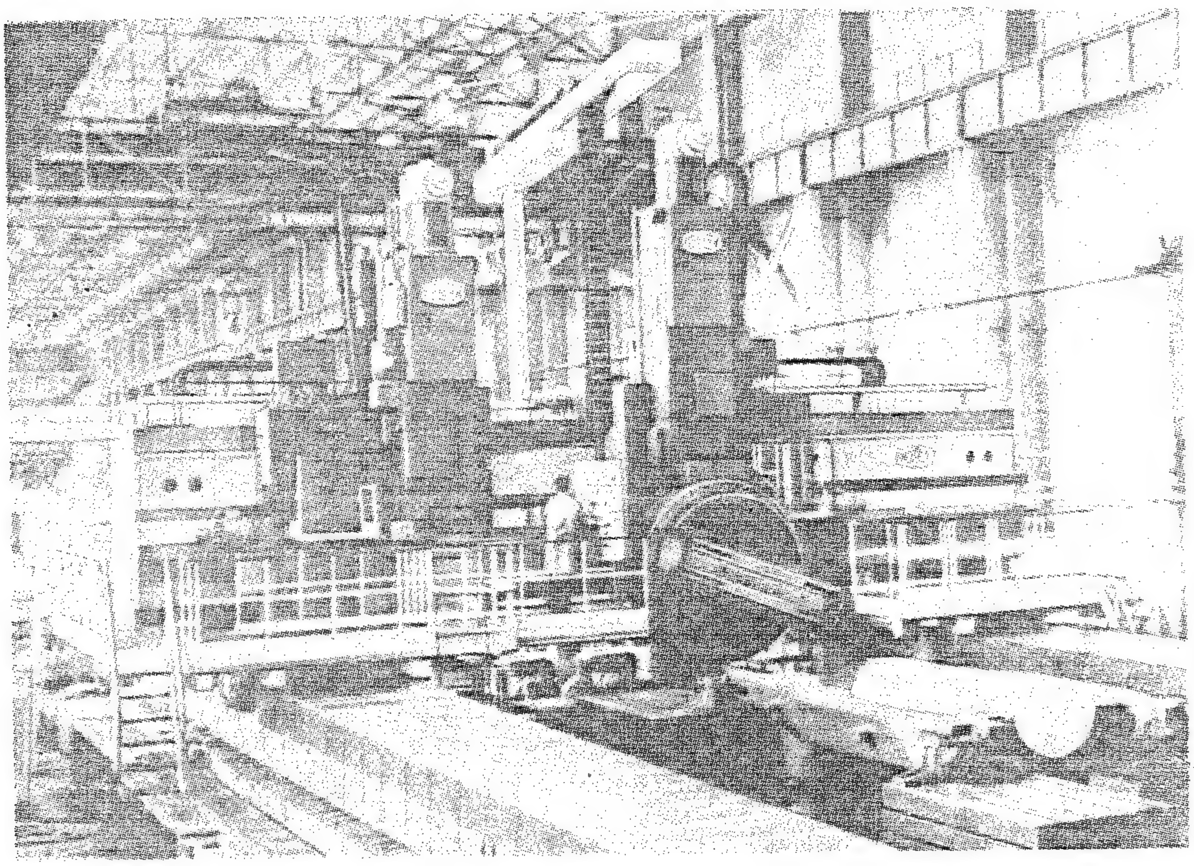
The machining center is made with a movable gantry. It can machine the lower and upper half of housings separately for cylinders of high pressure steam turbines for nuclear electrical power plants with steam-tight joints, matching mounting holes and bearing faces of turbines.

The movable gantry, along with reducing the area occupied by the center to 1/1.5 of that of a machine tool with a movable table, makes it possible to clamp another part on the bed plate in the process of machining one part.

This center is designed for CNC milling and boring, cutting large threads, as well as preliminary milling and boring holes up to 3800 mm in diameter in housings of large turbines.

The center is equipped with a positional CNC system to control along nine coordinates. The coordinates of the positions of any three units are indicated simultaneously on an overhead control panel.

The 170-ton gantry consists of two sleds, a crossrail, immovable in the vertical direction, two milling-boring carriages with a special boring head, electrical equipment cabinets and a CNC system. It moves along individual bedplates.



Model NC-33F2 CNC machining center

The horizontal and vertical guides of the gantry sleds are covered with lubricating material for smooth motion of the gantry (0.8 to 8000 mm/min) and positioning $\pm$ 0.01 mm.

The gantry is moved by two gear drives located on the left and right sides without play. Both drives are tied into a common kinematic chain above the crossrail. The parallel motion of the crane is monitored by sensors. If a shift of greater than 0.02 mm occurs, a tracking drive returns the gantry to the initial position through a differential device.

Two modes of alignment systems are provided -- dynamic and static. This is brought about by the necessity of obtaining high precision on an NC machine tool.

Milling-boring carriages slide over combination hydrostatic guides. Both 75 kw carriages rotate spindles with a frequency of 1 to 350 rev/min. The carriage slide blocks move down 2000 mm which, along with motion of the spindle of 800 mm, makes it possible to machine surfaces up to 3 meters deep with a crossrail immovable in the vertical direction.

A set of boring heads bores holes 700 to 3800 mm in diameter.

A group mechanized, rapidly readjustable device, developed by the All-Union Design Technological Institute of Power Machinebuilding, consists of two welded frames on which four welded brackets with a pneumatic drive are mounted. The drive sets up supporting points of the machined parts.

For the first time in heavy machinebuilding practice, a technology has been developed and introduced for separate machining of the center; a device for recording programs and a set of program carriers. The following were developed together with the VNIIinstrument: scraping tools, special cutting and measuring fixtures and a group mechanized rapidly-readjustable device.

The center has been operating for the fifth year in one of the turbines plants.

The total saving from the introduction of one center during its entire service life is over 1.5 million rubles.

2291
CSO: 1823/97

OTHER METALWORKING EQUIPMENT

UDC 061.43: 621.3.038.8

SPECIFICATIONS OF NEW INDUSTRIAL LASERS REVIEWED

Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZOVDSTVA in Russian No 6, Jun 84 pp 25-27

[Article by V. G. Osipova, engineer: "Lasers in the National Economy"]

[Text] An exhibition, "Use of Lasers in the National Economy," was held from October 1983 to March 1984 inclusive at the "Machine Building" pavilion of the USSR VDNKh.

Laser types made of solids, gas, semiconductor chemical and organic paints have found wide application in science and technology. Lasers are used in such various sectors of the national economy as instrument making, machinebuilding, machine tool building, automobile building, aviation equipment, construction, agriculture, etc.

Descriptions of the basic exhibits at the exhibition are given below.

Solid lasers of alumoyttrium garnets (AIG) in continuous operating mode types LTN-101, LTN-102, LTN-102B, LTN-103, LTN-401 and in the pulse single-mode with the Q-factor modulation types LTI-501, LTI-502, LTI-504, LTI-701, and LTI-702 are used in ophthalmological and surgical medical installations. A laser beam can cut metal sheets and plastic plates rapidly, precisely and noiselessly. The laser can replace a "hard tool." The laser beam melts material which is carried away from the cut by a gas jet. Type LTN and LTI lasers can weld difficult to weld metals and alloys; they can diagnose various media; they can cut metals, plastics, glass and ceramics; they can monitor the quality of materials; they can record data and draw pictures on metallic and nonmetallic surfaces; they can cut out materials in the textile industry.

Lasers are water-cooled. The cooling system is double-loop; the outer loop is connected to the water supply network, while the inner loop is filled with distilled water.

Lasers receive their power from a three-phase 380/220 volt network. Not over 10kva power is used.

Lasers are made of separate units: a radiator, an ignition unit and a power source with a built-in cooling unit.

The UFL-1 laser physiotherapeutic installation is used for the treatment of acute and chronic illnesses in the maxillo-facial area, as well as for treatment of ulcers and wounds that do not heal for a long time in dermatology, surgery (postoperative periods), gynecology and traumatology.

Red helium-neon is used in the installation, which is transmitted over a light guide formed by a system of mirrors with reflecting coatings. The light guide is movable which makes it possible to bring laser radiation to hard to reach sections. A preparatory low intensity beam is used to focus the laser on the affected section. The radiation power can be attenuated to ½ and to 1/6. A given exposure is obtained by a time relay.

Specifications

Radiation wavelength, micrometers	0.63
Power of beam radiation, milliwatts:	
working, not less than	20
preparatory, not more than	2
Density of radiation on object, milliwatts/cm^2	50-150
Continuous operation time, hours	8
Weight, kg	110

Table

Laser specifications

Type of device	Radiation wave length, micrometers	Average radiation power, watts	Pulse frequency, kHz	Beam diameter at output, mm	Beam divergence radius	Weight, kg
LTN-101	1.064	63	-	4	$1.0x10^{-2}$	190
LTN-102A	1.064	125	-	4	$1.0x10^{-2}$	220
LTN-102B	1.32	31	-	4	$1.0x10^{-2}$	220
LTN-103	1.064	250	-	4	$1.2x10^{-2}$	340
LTI-501	1.064	8	5-50	1.5	$1.0x10^{-3}$	225
LTI-502	1.064	16	8-50	1	$2.0x10^{-3}$	225
LTI-504	1.064	4	5-25	2	$2.0x10^{-3}$	280
LTI-701	0.532	4	1-25	0.8-1	$1.5x10^{-3}$	225
LTI-702	0.532	2	1-25	0.8-1	$1.5x10^{-3}$	225

The "Sayany-MT" laser scalpel does surgical operations with simultaneous coagulation of the tissue and minimal blood losses. It is used in oncology, gynecology, proctology and general surgery.

The positive effect in using the laser scalpel consists of reducing the necrotic zone of tissue damage, bloodless operations, ideal sterility and no postoperative scars.

The optical system of the apparatus focuses the laser radiation on a spot 0.1mm in diameter and regulates the depth of focus. The output power of laser radiation is regulated and monitored smoothly. The laser beam can be interrupted during an operation. A special suction system removes gaseous products that are formed in the process of the operation by the interaction between the biological tissue and the infrared radiation.

Specifications

Radiation wavelength, micrometers	10.6
Maximum power of laser radiation, watts, not less than	35
Diameter of focused beam, mm	0.1-0.5
Continuous operation time, hours	8
Average consumed power, kw	1.7
Weight, kg	350

The "Kvant-15" laser installation is designed for seam or point welding of ferrous, nonferrous and refractory metals, piercing holes, as well as for heat treatment (hardening, annealing, normalizing, etc.) and cutting various materials.

The optical system of the installation focuses the laser radiation pulse on a spot of a required size. The focused power pulse cuts or melts the material and welds it.

Specifications

Average radiation power, watts, not less than	100
Maximum radiation energy, joules:	
at a pulse frequency of 10Hz	up to 10
in single pulse mode	up to 15
Repetition frequency of radiation pulses, Hz:	
for pulse lengths of 2.0; 2.5; 4.0 milliseconds	0.1-10
for pulse length of 1.5 milliseconds	up to 20
Range of radiation spot size regulation, mm	0.25-3.0
Maximum thickness cut in ferrous metals, mm	up to 5
Piercing speed in materials up to 1mm thick, holes per second	20
Maximum cutting speed, mm/min	up to 350
Depth of melting when welding ferrous metals, mm	up to 0.8-1.0
Welding speed, mm/min	up to 350
Maximum depth of holes, mm	up to 10
Speed of heat treatment (linear), mm/min	up to 1000
Power consumed, kw, not greater than	12

The "Kvant-20" installation is designed to cut sheets of thermally polished glass when manufacturing electronic equipment. The glass is cut by a controlled thermal cleavage method, i.e., the glass is separated along its entire thickness by a crack, produced by a solid state AIG laser beam when it moves along the separation trajectory.

The regulation of laser radiation power and the speed of the motion of the material and the diameter of the radiation spot on its surface, in combination with the photoelectric adjustment indicator, make possible easy readjustment of the installation for cutting glass of various brands and monitoring the cutting mode.

The absence of contact, wastes and the great purity of the surface cut eliminates contamination of the surface of the products in the process of cutting.

Specifications

Radiation wavelength, micrometers	1.06
Radiation power, watts	63
Cutting speed, mm/min	60-360
Dimensions of initial glass sheets, mm	from 100 x 50 x 1
Width of obtained intermediate products, mm	up to 150
Allowance for dimensions of intermediate products (accuracy of separation), mm	0.2-1
Weight, kg	400

An automatic laser engraving device makes offsets directly from originals, bypassing photoreproduction and photochemical processes. The original, with shaded or half-tone pictures on a nontransparent or transparent base, is secured on one cylinder of the automatic device, while the forme plate is secured on another cylinder. The forme material is smooth aluminum foil with a previously applied varnish sublayer, which absorbs laser radiation, and a polymer antiadhesion coating.

The electrical optical system reads the original line by line, converting the optical image into an electrical signal, which controls the laser beam through a modulator.

The automatic laser engraving device automatically makes offset forms that contain shaded, as well as half-tone pictures.

In offset printing, labor-intensive operations using liquids are eliminated, no materials containing silver are used and previously prepared forme plates can be used. This reduces the share of manual labor, increases the stability of the quality of the printed forms, reduces the technological cycle time for manufacturing the printed forms, the amount of equipment used, production areas and service personnel.

The automatic device can also be used for engraving shaded and half-tone pictures on plastics, wood and other nonmetallic coatings.

Specifications

Linear recording speed (variable), meters/min	up to 300
Size of forme plates, mm	370 x 450 and 530 x 650
Minimum size of recorded lines, mm	0.1
Screen sets, lines/cm:	
for line pictures	120, 150, 200, 300, 600
for tone pictures	35, 42, 53, 70
Time for making an offset form 370 x 450mm, min	20

The EM-220 laser semiautomatic scriber device is used in manufacturing integrated microcircuits and other semiconductor devices in microelectronics.

Specifications

Plate diameter, mm	up to 150
Depth of cut for scribing speed of plates of 100mm/sec, micrometers, not less than	150
Error in motion of coordinate table in length of 150mm, micrometers	± 1.5
Laser radiation power, watts	16
Speed of motion of coordinate table, mm/sec	10-390
Compressed air consumption, m^3/hour	1.5
Pressure, megaPa:	
compressed air	0.4-0.5
vacuum network	0.02-0.04
Consumption of drinking water, m^3/hour	1.5
Size, mm:	
scribing installation	1040 x 1340 x 1310
power and cooling unit	550 x 600 x 1200
Weight, kg	500

The annual saving from the introduction of the semiautomatic device in production is 370,000 rubles.

An NC computer controlled laser marking installation is designed to inscribe alpha-numeric, coded and arbitrary graphic pictures on practically any solid materials. The source of laser radiation is an AIG type LTI-502 laser with a radiation wavelength of 1.06 micrometers, operating in the Q-factor modulation mode. An "Elektronika-60" computer is used to control the radiation mode of the laser, as well as the operation of the deflectors.

The laser marking installation can mark electronic equipment such as silicon plates, photo templates, microcircuits, transistors, plug couplers, crystals, as well as machinebuilding products such as ballbearings, automobile and plane parts, tools, etc.

Laser installation is fast, extremely flexible, requires minimum readjustment time, uses no contacts in the process and can make inscriptions on transparent materials.

Specifications

Radiation wavelength, micrometers	1.06
Radiation power, watts	16
Operating mode	single mode, pulsed
Marking speed, characters/sec	up to 20
Size, mm:	
type	0.5-100
marking field	50 x 50; 100 x 100
Size of installation, mm:	
machine tool	1600 x 800 x 1450
power supply	600 x 800 x 900

The LSU-1 laser light-musical device expands the possibilities of recreation programs, by creating dynamic light effects. During musical performances, the scintillating laser beam forms a multiplicity of clear figures and pictures, on the projection screen, whose patterns are changed depending upon the changes in the tone and rhythm of the music. Bass notes are especially loud in creating a strong rhythmic effect. The operator can control the nature of the pattern, expressing his individual perception of the musical composition.

The device is in the shape of a small suitcase carrying an ILGN-203 laser radiator. The principle of the device is to create various pictures by the laser beam radiation by changing its position in space by an optical-mechanical unit and radio-electronic control. It operates automatically and manually.

Specifications

Laser radiation power, milliwatts, meters, not less than	1
Maximum size of light picture, projected a distance of 10 meters, meters	3 x 3
Power consumed, watts, not greater than	100
Average life, hours, not less than	3000
Size, mm	540 x 110 x 220
Weight, kg, not greater than	7.5

The LZhI-501 readjustable pulsed laser using organic compounds for laser excitation is designed for scientific investigations in such areas as spectrascopy, nonlinear optics, isotope separation, resonant interaction between biological objects, etc.

The basic features of this laser are: smooth readjustment of the wavelength in the ultraviolet range; high monochromaticity of output radiation; high values of pulsed and average powers; high frequency of pulse repetition (up to 50Hz).

The device consists of an LTI-401 excitation laser, a smoothly readjustable frequency converter using solutions of organic compounds and nonlinear crystals, an excitation organic compounds unit and a platform.

The LTN-402 continuous double-frequency laser is designed for use as an optical radiation source in optoelectronic disk memories and in video and sound recorders for determining and monitoring optical characteristics of materials and units, as well as for scientific research.

The laser consists of a radiator, a power source and units to control the nonlinear component mode and cooling. The basic radiation frequency is doubled within the laser resonator in a barium-sodium niobate crystal. Due to a specially selected laser resonator and the control of the output characteristics by means of electronic devices with feedback according to the basic radiation of the second harmonic, the LTN-402 laser is distinguished by the power distribution along the transverse cross section of the beam and by the high stability of the output radiation.

Additional advantages of the laser are the small sizes of the power supply and the control and cooling units.

Specifications

Radiation wavelength, micrometers	0.532
Operation mode	continuous, single-mode
Average radiation power, watts, not less than	0.3
Noise level of radiation power, %, not greater than	3
Laser radiation beam diameter in level 0.1 of power distribution, mm, not greater than	2.5
Average electrical power consumed, kw, not greater than	2.5
Weight, kg, not greater than	75
Operating time to failure, hours, not less than	500
Size, mm:	
radiator	180 x 650 x 140
power supply	480 x 480 x 160
control unit	480 x 480 x 120
cooling unit	480 x 480 x 160

2291
CSO: 1823/95

OTHER METALWORKING EQUIPMENT

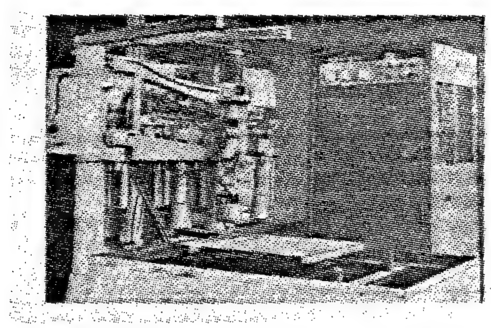
TWO NON-TRADITIONAL METALCUTTING MACHINE TOOLS

Moscow EKONOMICHESKAYA GAZETA in Russian No 36, Sep 84 p 23

[Text] The Kirovakan "Avtogenmash" Plant manufactures ShPL-1-4M-1 air plasma cutting machines for cutting parts of nonferrous metals and stainless steel according to metal templets in blank preparation shops of metalworking enterprises with small series and series production.

The maximum size of the cut parts are 1000 x 1000 and 1500 x 750, maximum thicknesses of the sheets are: stainless steel - 60mm, aluminum -- 70mm and copper 50mm; feed voltage 380 volts; cutter speeds 100-4000 mm/min; speed of regulation -- stepless; size of machine (without APR-402 device) -- not greater than 950 x 1910 x 1800 mm, with device APR-402 -- 840 x 700 x 150 mm; weight not greater than 1832 kg.

The machine is of the articulated type and consists of a column, outer and inner frames, overarm, holders, power supply and control panel. It is equipped with a unit to maintain the distance between the jet and the cut metal constant. The cutting process can be controlled by an extension control panel. It can be services by one operator.



ShPl-1-4M-1 plasma cutter.

Articulated ASSh-70 (ShK-1-1,6M) machines are used for irregular shape and rectilinear separation oxygen cutting with one or three cutters of low carbon sheet steel according to metal templates (using pantograph attachments).

The greater thickness of the sheet when operating with one cutter is 150 mm, with three cutters -- 100 mm. The maximum size of cut parts when using one cutter is 1500 x 750 or 1000 x 1000 mm, with three cutters -- 1300 x 400 mm or 400 mm in diameter. Supply voltage is 220 volts, power consumption is 0.1 k2, cutter speed range is 100 to 1600 mm/min, speed regulation -- stepless. Machines size (with extented frames is 1910 x 950 x 1800 mm).

The machines is of an articulated type and consists of a column, outer and inner frames, an overarm, holders with cutters, a power, supply and a control panel. It is serviced by one operator.

Acquisition requests should be directed to the manufacturing plant at the following address: Kirovakan, 377200, Tumanyan Street, 8 tel. 2-13-58.

2291
CSO: 1823/75

OTHER METALWORKING EQUIPMENT

UDC 621.983.06-62-52

NEW HIGH SPEED AUTOMATED SHEET STAMPING MACHINES

Moscow KUZNECHNO-SHTAMPOVOCHNOYE PROIVODSTVO in Russian No 5, May 84 pp 31-32

[Article by A. N. Katrakhov: "High Speed Automated Machines with a Bottom Drive"]

[Text] The automated machines were designed by a special design buro of forge-press machines and automatic lines and were manufactured by the Taganrog "Pressmash" Production Association.

The machines were designed to manufacture a wide product list from roll material by cold stamping in mass and large series production and will be used instead of the outdated AB automated machines.

Specifications	AV6224	AV6228
Nominal force, k newtons	250	630
Number of continuous strokes per min. (regulated)	125-800	80-800
Path of slide block to its extreme lower position at which the machine develops its nominal force, mm	2.0	2.8
Distance between table and slide block in its lower position in the upper, regulation position, mm	250	360
Value of regulation distance between table and slide block, mm	50	63
Distance between guide bushings of columns to light, mm	450 x 200	710 x 360
Sizes of holes in table, mm	360 x 160	560 x 250
Maximum sizes of band, mm:		
thickness	2.0	2.8
width	160	250
Maximum feed, mm	110	180
Thickness of plate under die, mm	50	80
Speed of band feed (maximum), m/min:		
with tong feed	50	50
with roll feed	20	20
Vertical rigidity, k newtons	750	1200

Size of machine (without control panel) mm:		
from left to right	1900	3000
from to front to rear	1300	1500
height	1800	2120
Height of table above floor, mm:	1100	1100
Main drive power, kw	10	20
Weight (without truing-unwinding device, tons:		
with tong feed	3.5	7.2
with roll feed	-	7.5

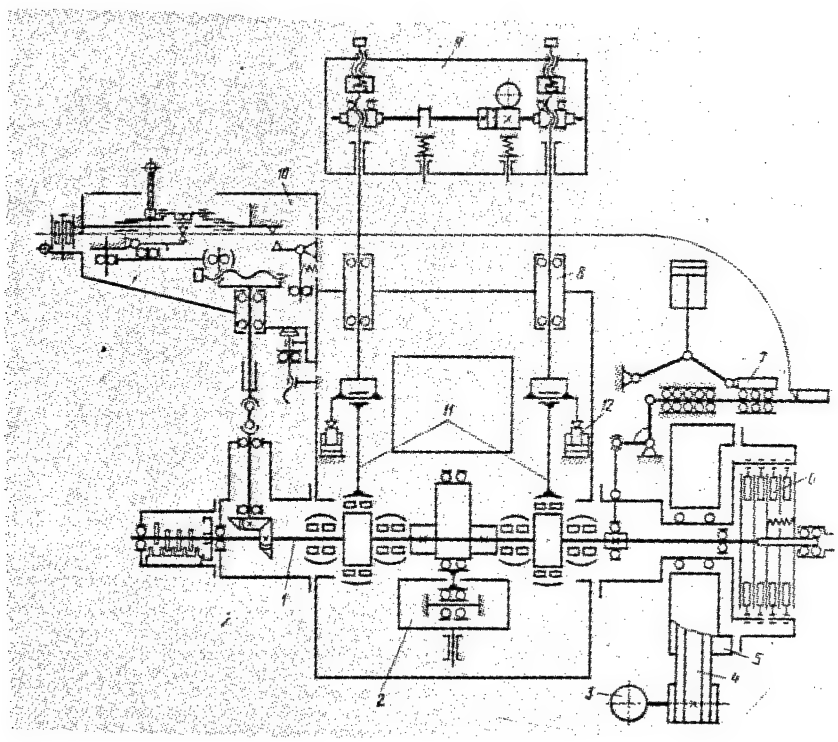


Fig. 1

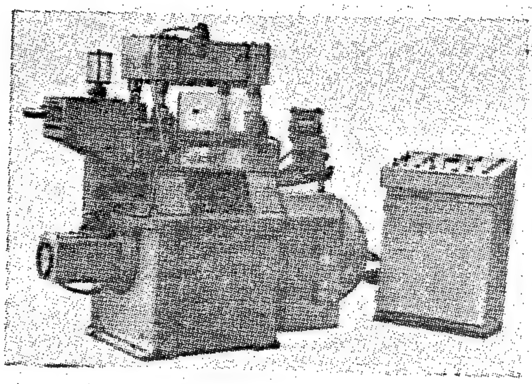


Fig. 2

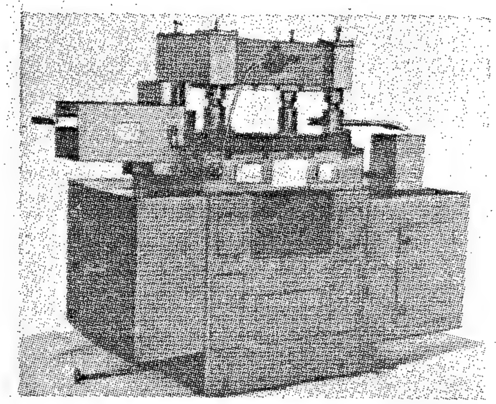


Fig. 3

The structural arrangement of the model AV6228 automatic machine is shown in Fig. 1; the general view of model AV6224 is shown in Fig. 2; and of model AV6228 in Fig. 3. Eccentric shaft 1, installed on four antifriction ball bearings parallel to the front of the machine, is driven by DC electrical motor 3 with stepless-regulated rotation frequency through a V-belt drive and a rigidly assembled pneumatic clutch 6, built into a flywheel 5.

Two connecting rods 11, mounted on ball bearings on the eccentric shaft, drive slide block 9 in reciprocating motion on ball-bearing guideways. Feed 10 and shears 7 are moved by the eccentric shaft.

The model AV6224 machine differs from the AV6228 machine by the fact that the eccentric shaft has two bearings.

The new automated machines have a number of essential advantages over the present ones.

The maximum number of strokes of the slide block increased and the regulation range of the number of strokes were increased.

The maximum speed of the band feed to the die was increased.

Energy friction losses in the crankshaft-connecting rod were reduced due to the use of ball bearings for the eccentric shaft and connecting rods.

Device 2 is used for dynamic balancing of the reciprocating motion of moving weights with the correction for the weight of the upper half of the die by a pneumatic counterbalance 12, which makes it possible to operate the automatic machines without special foundations in the entire range of strokes.

The electrical drive has a two-zone regulation.

The control switch and the crankshaft position indicator were moved to a location more convenient to service.

Shears for cutting off waste are equipped with AC that makes it possible to cut the band into pieces, multiples of the feed pitch.

The eccentric shaft is relieved of the weight of the flywheel.

Electrodynamic braking of the flywheel by the main drive was introduced.

The new design of the table and bedplate make it easy to install and dismount the eccentric shaft without removing the machine from the foundation.

The weight was reduced by using welded structures for base parts.

Metal saved in the manufacture of new machines is shown in the Table.

Table

Machine model	Metal saved per machine, kg nonferrous	ferrous
AV6224	23.8	800
AV6228	40	2000

The machines can be furnished with the following feeds -- tong, shaft pushing, shaft pulling, two-sided rolls; a truing-uncoiling device and shears for cutting the stamped band.

A coiling device can be supplied on customer's orders.

Specifications for truing-uncoiling and rolling devices

	PU-250	PU-16	NU-250
Tape size, mm:			
width	60-250	30-250	60-250
thickness	0.5-2.8	0.25-1.6	0.5-2.8
Speed of truing-uncoiling and coiling, m/min.	2.4-24	3.-50	2.5-24
External diameter of roll (maximum), mm	1200	1250	1400
Internal diameter of roll, mm:			
maximum	600	600	300
minimum	300	330	-
Number of			
truing rolls	7	13	-
uncoiling drums	2	2	-

Regulation of uncoiling-coiling speeds		stepless	
Power of electrical motor, kw	4.5	4.5	4.5
Size in plane, mm	2465 x 1550	2450 x 1485	1420 x 1000
Height above floor, mm	2040	1590	1500
Weight, tons	3.1	1.94	1.0

The automatic machines are equipped with centralized circulating liquid, lubrication of friction units, a spring pusher in slide block, a rigid pusher and a device for lubricating the bands.

2291
CSO: 1823/53

AUTOMATED LINES AND AGGREGATED MACHINING SYSTEMS

MINISTER B.V. BAL'MONT ON STATUS OF AUTOMATION DRIVE

Moscow PRAVDA in Russian 13 Dec 84 p 2

[Interview with B.V. Bal'mont, minister of the Machine Tool and Tool Building Ministry by PRAVDA correspondent N. Lyaporov: "The Industry at the Close of the Year," under the rubric: Words and Deeds: Checking Up on Performance of Responsibilities]

[Text] [In boxed insert]

Automated Equipment Saves Worker Labor

Example of Ivanovo workers

Quality of Robots Needs to be Improved--The Machine Builders' Urgent Task

Machine construction has been called the core of industry. But there is a field that has moved to the leading edge of the struggle for technical progress in machine construction itself. This is the tool and machine tool industry. The Ministry of The Machine Tool and Tool Building Industry provides the equipment for a whole range of industries accounting for more than a quarter of all industrial products and plans a major role in their retooling. This is also reflected by the socialist responsibilities of the machine tool engineers for 1984, as published in PRAVDA. In particular, that article anticipated the accelerated development of the production of the most advanced and efficient types of equipment, including machine tools, NC machines, automated production lines, industrial robots and robotic machine tool systems.

Are the workers of this important industry keeping their word? That was the subject of our interview with the minister of the Machine Tool and Tool Building Industry, B.V. Bal'mont.

[Minister's Statement] First some figures. The 11-month production plan was accomplished by 101.3 percent. In addition to the plan, 81 million rubles of goods were produced. The range of products is being updated more quickly than

before. In only the past 10 months of this year our enterprises have built 254 prototypes and adopted 244 new item production series. Another step has been taken in a major direction--boosting the production of automated equipment for various fields of industry.

The innovations in our industry are complicated customized machine tools and whole systems of automated high-production lines. For example, the Voronezh Association for Production of Heavy Mechanical Presses has built a powerful system equipped with manipulators for the Moscow ZIL. While raising labor by a factor of 1.5, this also saves 3,500 tons of metal per year in the crankshaft production. The Moscow Machine Tool Factory imeni Ordzhonikidze has completed construction of a system of automated lines for total machining of the Don combine's main assembly. It includes more than 160 machine tools. Replacing 750 workers, the system provides an economic impact of around 1.5 million rubles.

The development of such systems and advanced designs of equipment with numerical control, wholesale adoption of computer technology and advanced electrical automation is the main avenue of improvement in our products. A number of plants have been radically retooled, drawing on the assistance of scientific organizations and design agencies. NC machine tools are being fitted out with microprocessors with long term storage and the production of multiple-job machine systems (machining centers) is increasing. We are organizing the production of so-called flexible automated production modules, designed for fast and precise machining of specially-intricate parts.

The workers of the Ivanovo Machine Tool Association imeni the 50th Anniversary of the USSR have become the right flank in this important matter. They have developed an assortment of multi-purpose units that perform up to 10 different jobs continuously. They are developing machine tool modules that can be incorporated into flexible automated production systems. This is also helping encourage the practice of operation of several machines at the same time. In 11 months the Ivanovo workers have produced 216 'machining centers,' developed 10 flexible production modules, and have met their responsibilities. Their experience in shortening the program of development of complex state-of-the-art NC systems is being used today by many work temas. Enterprises have agreed to cooperate in the manufacture of units.

There has been a tangible increase in the centralized production of a number of standardized items used in the manufacture of new technology. For example, the relative share of these in the overall volume of production of hydraulic drives and automated hydraulic equipment has risen by 18 percent, including 26 percent for the 'maching center' type. Over 2,000 industrial robots have been built--more than planned. The labor productivity for the 11-month term has been raised 1.3 percent above the plan, and net costs of production have been cut an additional 0.7 percent. This is better than the expected commitments. Let me add: the results of the previous 3 years and the concluding 4th year show that the pace of production of automated equipment scheduled for the 5-year period is being sustained."

[Question] Are any enterprises lagging behind? What is being done to advance them?

[Answer] We are troubled that certain groups show unequal performance and have not fulfilled the plan for a number of months this year. Not all contracts are being strictly honored. Over the past three quarters 99 percent of the contracted deliveries have been made--better than the previous years. But even so there are gaps, and dozens of consumer enterprises are suffering on their account.

The all-union industrial associations and the personnel of the ministry are increasing their assistance to the backward parties. We are teaching them by the example of the best, using the expositions of industrial progress organized by the VDNKh SSSR [Exhibition of Achievments of the National Economy of the USSR]. Thus, the experience of the Kiev and Ivanovo Machine Tool Associations has become an excellent school for like enterprises. A seminar on adoption of the brigade form of labor organization and wages has been held at Ulyanovsk. Today, our bodies of workers are actively supporting an initiative to create a special savings fund and are developing future plans and commitments for 1985 where at least 2 full days will be financed by the economized resources. The industry is readying itself to take part in a broad economic experiment.

[Question] You mentioned flexible production systems. As you know, our industry should become the major supplier of automated metalworking equipment for them. More and more, flexible production modules, industrial robots and robotic technological complexes are required. Can you discuss what is being done here?

[Answer] Yes, the Ministry of the Machine Tool and Tool Building Industry has been instructed to introduce a unified technological line in the field of development of felxible automated production. Our industries will have to build the lion's share of all flexible production modules, increase their output and, most important, enhance their reliability. I already mentioned the achievements of Ivanovo. Also instructive is the experience of the Moscow Krasnyy Proletariy Plant, where a subsidiary has developed an automated production of robots in very short time.

The plant has stopped manufacturing the ordinary universal screw-cutting lathes and is increasing the production of NC machine tools, developing facilities for the production of robotic lathe assemblies. This is basically a new advance in the technical growth of the oldest enterprise in the field. A rapid reorganization was made possible by coordinating the efforts of all the organizations and enterprises taking part in the retooling of the plant.

A standard assortment of industrial robots is being developed and the equipment that will make use of these in the next 2 years is being determined. I should mention that the greatest impact may be achieved by developing robot technical complexes. The major and executive organizations for development of robot technology have been determined, bringing dozens of new enterprises into the picture. Basically, the goals are being met.

[Question] It is clear that this production may be satisfactory in quantity, but there are complaints as to its quality among the consumers. This has been shown by a recent inspection at a number of enterprises by the USSR National

Supervisory Committee. In particular, it was pointed out that departures from the blueprints are being tolerated in the manufacture of robot technology and reliability testing is not always done. There are instances where purchased robots are simply not being used. In short, serious defects have been found. What is being done to correct these and improve the situation?

[Answer] First of all, we are expecting better performance of delegated tasks. The results of an inspection have been discussed at a meeting of the members of the ministry. The chief engineers of the Kursk Forging Equipment Plant and the Voronezh Production Association for Forging Equipment have been reprimanded for violation of technical requirements and shipping of inferior products. Strong warnings have been issued to the managers of several other enterprises.

But the main thing is that measures have been developed and are being implemented to correct the matter. Specialists of the industrial associations and the scientific resources of the field are taking part. Further, test stands are being developed and an incoming inspection of assembly parts is being organized. The chief organization--the Scientific-Production Association ENIMS--has developed measures to strengthen the technical and organizational supervision and the coordination of work within and among the branches of the industry. We are paying special attention to the assistance of those that are introducing robots--training of personnel and proper operation of the new technology.

Our primary goal is to improve the quality and enhance the reliability of the manufactured equipment, especially automated equipment. The workers of the enterprises and the institutes in the field are aiming at this. At the same time, I should like to point out that scientific and industrial cooperation with other staff is indispensable, primarily the scientific institutes, design organizations and factories of Minpribor [Ministry of Instruments] Minelektrotekhprom [Ministry of the Electrotechnical Industry] and Minelektronprom [Ministry of the Electronic Industry].

12717
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AUTOMATED LINES AND AGGREGATED MACHINING SYSTEMS

UDC 621.73.043:658.011.56

AUTOMATED STAMPING LINE FOR CRANKSHAFT PRODUCTION

Moscow KUZNECHNO-SHTAMPOVOCHNOYE PROIZVODSTVO in Russian No 5, May 84 pp 16-18

[Article by I. N. Fil'kin and V. N. Gorozhankin: "Automated Line for Stamping Crankshafts and Front Axle Beams for ZIL-130 Automobiles"]

[Text] The Voronezh Heavy Mechanical Production Association (PO) manufactured an automated line (AL) with a 125 meganewton KGShP [Hot Crankshaft Stamping Press] (Fig. 1) for stamping crankshafts and front axle beams for the ZIL-130 automobile.

Specifications

Cycle productivity of stamping, piece/hour:	
crankshaft	75
front axle beam	95
Service personnel per shift	16
Maximum power consumption of electrical equipment, kw	6300
Dimensions, mm:	
from left to right	71,270
from front to rear	14,872
height above floor	10,240
Line weight, tons	2,122

The line operates as follows:

The billet is pulled two or four passes through 4 meganewton forging rolls by a manipulator which turns the billet 90° around a longitudinal axis after each roll pass. After the final rolling, the manipulator turns by 180° and moves the billet to the first impression of the KGShP die. The manipulators are located in the press stand. They move the billet into the final impressions of the die and install it on the conveyor, which moves the forging to the 12.5 meganewton trimming press. The manipulator loads the forging into the die. The press trims the fins on the first stroke and the forging drops on a conveyor located under the trimming die. A special device pushes the fins into a die where the second stroke of the press cuts the fins into several parts and are removed to packing. The beam forging is transported from the trimming press to a 16 meganewton sizing press where it is trued

and sized. The crankshaft forging is sent from the trimming press to a 4 meganewton twisting press where the bends are turned to the required angle and then the forging is sent to the sizing press for truing the shaft.

The program control system (SPU) was developed on the basis of programed controllers (PK) which is of a higher standard not only as compared to a relay-contact type, but also as compared to an electronic SPU with rigid ties. The difference is that in the electronic SPU with rigid ties, functional possibilities are determined by electrical ties between components, while in the SPU with PK -- by an electrical memory which can easily and rapidly be reprogramed, if necessary.

SPU with PK has a number of advantages as compared to previous control systems: essential (up to 30-40 percent) reductions in start-up and setting-up times; the possibility of extensive diagnostics of the condition of electrical devices for preventing breakages; sharp reduction in the idle time of equipment (up to 50 percent) by rapidly finding causes of failure in the control system; possibility of a rapid change in parameters of the technological cycle.

A special feature of the line is the SPU arrangement with two levels. The first level has the properties and possibilities described above. The second level is designed for solving the following problems: record operating and idle times of the line equipment; record idle time of repair services; monitor the service life of the tool and organize planned changes of tools; accumulate and systematize data on the operation of individual equipment units; issue instructions on periodic servicing.

The SPU line along with the PK contains original production units to manufacture heavy presses for assembling, and for primary processing and transmitting of discrete information. Thus, the SPU line can be joined with the ASU [Automatic Control System] of the shop or plant as a whole.

The working design of the basic unit of the line -- the 125 meganewton KGShP (Fig. 2) was preceded by the manufacture and investigation of a 63 megaton press on which all basic design decisions and principles were checked out such as: reduction in friction losses and power consumption by introducing liquid circulating lubrication of all basic bearings and gears, a considerable increase in the eccentricity of stamping by a double connecting rod suspension of the slide block; reduction in the time for die adjustment by transferring the device for adjusting the closed height to the slide block, etc.

The press is equipped with an electronic force meter which blocks the next stroke of the slide block when an overload originates. The overload force appears on a signal panel. The hub of the clutch is connected to the shaft by a conical bushing without keys. The hub is mounted when hot and is removed by a hydraulic device. The press is equipped with quick-acting clamps of the stamping unit and a device for its change.

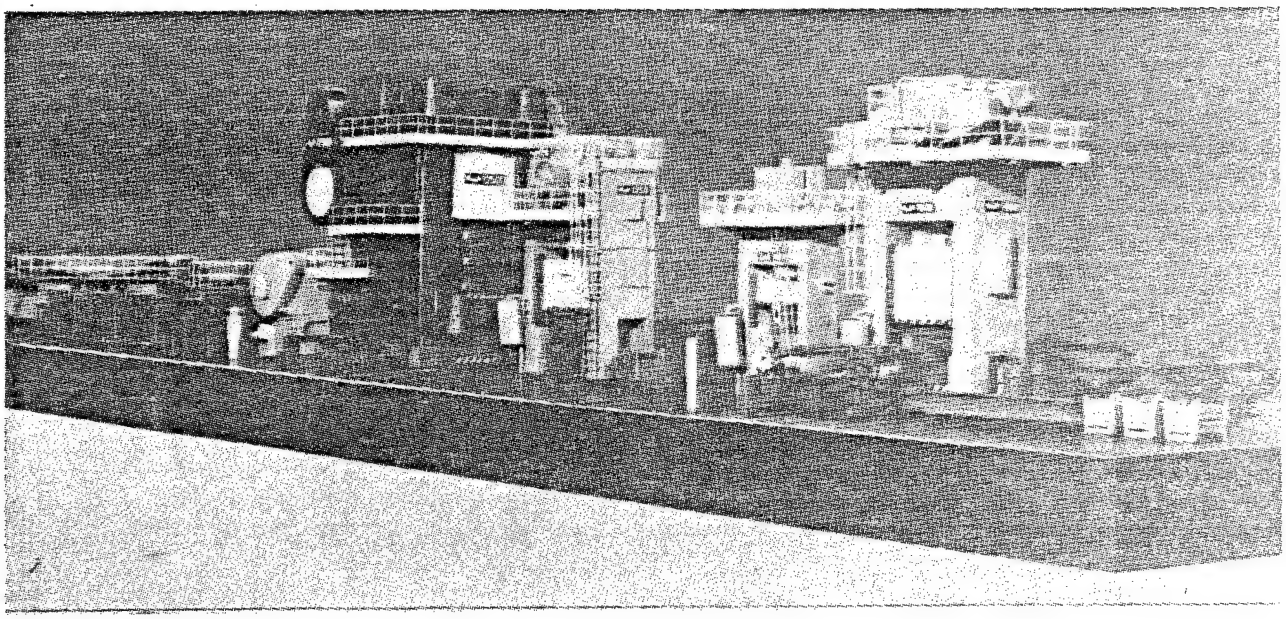

Fig. 1. Automatic line for stamping crankshafts and front axle automobile beams of trucks (prototype)

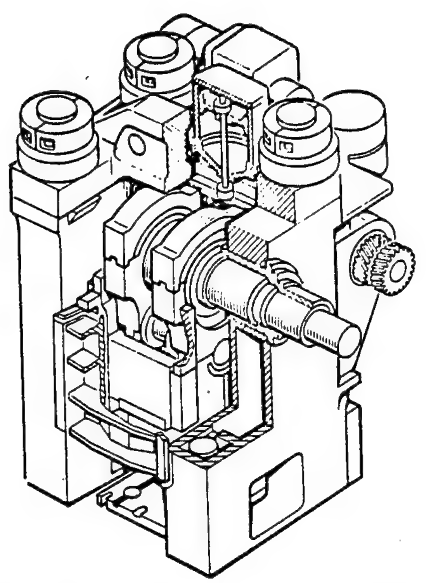

Fig. 2. General view of a 125 meganewton KGShP.

In designing powerful KGShP, it is necessary to study actual stresses in base parts throughly which, in view of the considerable weights, must be designed, taking into account the limitations imposed by manufacturing conditions, machining and transportation.

The finite component method is used to calculate stresses in the bed, slide block and the eccentric shaft. Boundary conditions that determine the precision of the calculations, measured in the design structure of the press model, are obtained from the analysis of actual stresses in the press model. Average stresses in the bed components were obtained as a result of the analysis of preliminary stresses produced by the bed tie bar and by the working load.

In designing the 125 meganewton KGShP, the PO specialists made a comprehensive investigation under operating conditions of a 120 meganewton hot-stamping press at KamAz. The operating values of technological operations were obtained of actual forces in stamping crankshafts and front axle beams in all die positions. Moreover, values of the slide block shift and the stress in the press table were determined. Investigation results of the 120 meganewton press and of the 63 meganewton KGShP were taken into account in the design calculations for the 125 meganewton press, whose base parts were calculated by the finite components method. Experimental investigations of the 125 meganewton KGShP made it possible to refine the initial data for designing powerful KGShP using the SAPR [Automatic Design System].

One of the basic difficulties in developing greater than 80 meganewton KGShP is the development of design solutions corresponding to production-technological possibilities of manufacturers and transportation facilities.

One basic direction in developing automated equipment for hot die forging is creating flexible automated production facilities (GHP) using rapidly readjustable complexes and lines with wide technological possibilities for a wide list of parts. If automated units are fairly efficient for large series and mass production, then GAP are profitable even for series production because they can be readjusted easily from one type of a product to another.

In the light of this trend in the development of forge production facilities, experience in developing an automated line for stamping crankshafts and front axle beams determines the way to improve lines of this type which must meet the following basic requirements.

1. Possibility of rapid change in the composition of units in the production cycle, depending upon the technological processes for obtaining the forgings;

composition of the line, its arrangement, transportation ties and the SPU must exclude individual units or their replacement from the technological process by equipment installed in parallel for the simplification of solutions, improvement of operation of shop transport and crane equipment.

2. The productivity of any unit in the line must not be less than the productivity of the KGShP.

the equalization of the equipment must be achieved either by a parallel installation of the required number of units, or by the creation of high productivity machines for the full utilization of the possibilities of the special design press;

the cyclogram of the KGShP operation to raise its productivity should combine manufacturing stamping steps when the power of the press permits this.

3. High universality, high speed and precision of the positioning robots:

many degrees of mobilities of robots (up to 6) and high speed of changing grips;

an electrical drive for moving robot arms (for example, DC motors with a disk rotor) with a microprocessor for monitoring and regulating the motion speed;

the SPU must be able to program the robot by training it in the manual manipulator mode.

4. It should be possible to use the heating installation for a wide list of intermediate products;

change of induction coils due to malfunctions or change from one cross section range of the intermediate product to another must be automatic;

automated devices for loading and unloading intermediate products should be able to operate with products of various lengths and cross sections;

thermostats should be switched-in automatically when the line stops briefly.

5. It should be possible to replace (15 to 20 minutes) the stamping tools in all line units rapidly;

stamping dies for each line unit must be standardized for any tool set;

tool change at the KGShP should be made by replacing the stamping die with the tool heated outside the press according to a given program;

the line must be equipped with an automated section for rolling over the KGShP stamping dies, where the upper and lower halves of the die are separated and installed in a position convenient for changing the tool;

the rolling over section must be connected by transportation and hoisting facilities with the press and tool warehouse; besides, it must be equipped to replace and repair the tools (for example, pneumatic impact wrenches and grinding machines).

Taking into account the enumerated requirements the Voronezh Heavy Machine Press Manufacturing PO is designing at present 80 and 125 meganewton KGShP lines for the "Avtogaz" PO and the Taganrog Combine Plant.

The expansion of the KGShP up to 160 meganewtons and the development on their bases of automated lines attest to a qualitative leap in the process of changing hammer dies when stamping forgings with a weight greater than 60 kg in order to increase productivity, save metal and improve labor conditions.

2291
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TECHNOLOGY PLANNING AND MANAGEMENT AUTOMATION

UDC 658.5.011.56:006.065

SHORTAGE OF SOFTWARE ENGINEERS SLOWS FMS DEVELOPMENT

Moscow STANDARTY I KACHESTVO in Russian No 9, Sep 84 pp 19-20

[Article by Gerts, candidate of technical sciences: "Special Features for Technical Preparation for Flexible Automatic Production"]

[Text] At present, progress in the development of microprocessor techniques and robot building created premises for the comprehensive automation of small series, series and mass production (with rapidly changed objects) by creating industrial systems with flexibly readjustable equipment -- flexible automated production facilities (FMS).

The efficiency of such technological systems cannot be considered as the sum of efficiencies of its various components; it increases many fold, due to the possibility of optimizing many aspects of production: loading equipment, transport routes, warehouse reserves, repair schedules, etc. which, naturally, is achieved only by taking into account all interrelated factors in the design process of various components that enter into the technological system, as well as, which is especially important, when using corresponding mathematical methods, implemented during functioning of the system.

As is known, according to GOST 14.101-73, the TPP [Technological Preparation for Production] is a process of developing and implementing measures to insure TPP functioning and correct the progress of operations when deviations originate, including solving problems of planning, accounting, monitoring and controlling. Automation of TPP control in FMS has two aspects.

First, processing all control data by computers whose design principles practically do not differ from the principles of designing automated production control systems (ASUP) of which these systems are, to some extent, a component part. At present, with the appearance of computer networks, dialogue modes of their interaction with management and integrated data banks, this automation aspect a quires special importance.

Secondly, the adoption of management decisions in FMS, expressed otherwise, is an aspect of automation related to the formalization of planning processes of the operation of technological equipment and automated transport-warehousing networks, based on mathematical optimization methods.

Unlike nonautomated production where the utilization of these methods is difficult due to high labor-intensiveness and the complexity of obtaining the required primary data, the automation of the FMS is implemented, naturally, as a necessary process for adopting a solution without which flexible automation is simply impossible. In other words, mathematical optimization methods must be included in the FMS as standards. Therefore, in creating practically any FMS, designers must restudy anew each time all technological and mathematical optimization problems.

Actually, in creating FMS, there is always a new in principle situation where the adopted technological solutions on the arrangement of the technological equipment, organization of production and its preparation require from technologists-designers and production organizers the knowledge and ability to utilize mathematical optimization methods, and from software specialists -- a clear concept of all technological and organizational aspects of automated production.

To develop and program mathematical optimization methods, it is necessary to attract highly skilled specialists since the efficiency of these methods depends on posing the problem itself, i.e., the object of optimization, the assumed limitations, initial data and interaction with other software components.

Regrettably, at present, the number of such specialists is very limited which creates difficulties in designing FMS.

One of the cardinal methods for solving the problem is standardizing the optimization methods in the FMS. Today, it is too early to talk about the expediency of standardizing technological preparation for the FMS in the part of its structure, data content, etc., in view of the newness of the question itself, and the lack of any essential experience in this area. Yet, the standardization of optimization methods is not only entirely modern, but is necessary for developing flexible technology in every way because it will make it possible to reduce labor-intensiveness and schedules; improve TPP quality, including efficiency; increase equipment loading and reduce FMS operating costs; and reduce production costs, etc.

The following should be standardized: list of the problems in technological preparation for production of FMS (TPP FMS); optimization objects; precedures for selecting optimization methods; mathematical optimization methods themselves -- optimization algorithms and parameters; forms of representation and data output of optimization problems, etc.

Standards must include the following: interesting posing of the problem (description of the calculation method itself); the calculation algorithm in the form of a block diagram, as well as corresponding listings with user instructions.

In our opinion, the SM-4 computer or its modifications should be used as a basic computer to develop programs for the TPP FMS because they are most suitable for operation at the middle management level, between levels of FMS in real time and an automated production control system (ASUP of plant or shop, if it is used).

All standard optimization programs must have a finished aspect and be formalized as subprograms that may be taken from the library of programs for operational system optimization.

Actually, the entire set of optimization standards must be made up as a part of an automatic design system (SAPR) TPP FMS. In this connection, the structure of such a set of standards becomes of special importance.

Obviously, standards "List of problems for technical preparation of FMS to be optimized" and "Procedures for selecting optimization methods" must be developed first because they are important in forming the structure.

In creating optimization standards, it is necessary to take into account the operation of the standardized product program in two modes: in the automated mode as a part of the general SAPR TPP FMS and in the nonautomated mode in the manual TPP design.

In the first case, standardized program product, apparently, will be made up as a program module and can interact with other SAPR parts through a common data base.

In the second case, it is necessary to develop a standard language for describing data for their introduction into the computer system so that the two input modes would not contradict each other.

We will cite as an example a typical list of TPP FMS problems which, in our opinion, must be optimized first:

selection of an optimal technological process for manufacturing products;

optimization of the FMS technological equipment loading;

selection of optimal transportation routes;

optimization of intersection stockpiles of semifinished products;

determination of the optimal time for the start-up of products in production with the technological equipment in the FMS according to the assigned time for the output of the product, i.e., develop optimal "start-up-output" schedules;

optimization of repair schedules for the FMS technological equipment taking into account its actual wear, determined in the automatic mode, and the operating time;

insurance of technological efficiency of product design by optimizing itss dimensions and allowances for them.

This far from a complete list attests to the fact that technical preparation for the FMS cannot be separated from solving optimization problems. Of course, these problems also exist in the usual nonautomatic production, but there they are solved on the basis of the experience and intuition of specialists. In automated production, however, these problems must be formalized and expressed in mathematical language, and, therefore, optimization is the natural way to solve them.

The standard set of optimization methods must include all known methods: language multipliers, nonlinear and dynamic programing and variational methods. The selection of the method must be implemented automatically depending upon the TPP problem, its dimensions, parameters and other factors, required for FMS control.

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TECHNOLOGY PLANNING AND MANAGEMENT AUTOMATION

UDC 65.011.56:681.3

EFFORTS AT UNIFYING CONTROL SYSTEM FUNCTIONS

Moscow STANDARTY I KACHESTVO in Russian No 9, Sep 84 pp 20-23, 44

[Article by M. Yu. Gornshteyn, candidate of economic sciences (TsNIIKA): "Efficiency of Using Typical Solutions in Creating ASU"]

[Text] The use of computers and automatic control systems (ASU) in industry is implemented stage-by-stage: The principal possibilities were investigated for the control of complicated technological and organizational economic process using computers were investigated in the Eighth Five-Year Plan period. In the Ninth Five-Year Plan period, the control of a limited number of complicated facilities in industrial production was realized and in the 10th Five-Year Plan period, there began wide use in many industrial sectors of ASU of prototype systems, developed and previously tested under industrial conditions.

At this stage, in connection with increased national economic requirements, an urgent necessity arose in industrial methods to develop, introduce and disseminate ASU.

Standardization was called upon to play an important role in solving this problem because providing for the increasing requirements of the national economy was possible only by creating typical ASU and their standardization that would make it possible to change over from developing and introducing individual experimental systems which are labor-intensive and expensive to truly industrial principles for creating ASU on the basis of organizational methodological and technical unity.

ASU standardization spans problems of the general systems for organizational, technical informational, mathematical, methodological and program software. Fairly, many state standards already function in this area. At present, a work program on the creation of a single system of standards for ASU is being implemented.

ASU standardization makes it possible to improve the organization of scientific research and planning design work and to utilize advanced experience in creation and operation widely. It provides for the manifold use of standard

components, regulates and standardizes methods and procedures for creating data forms and documentation requirements, and makes it possible to monitor the progress of the ASU creation efficiently.

The economic effect from standardization comes from a reduction in labor-intensiveness, cost and time for creating the ASU and an increase in their quality and efficiency.

The industrial approach to creating the ASU is based primarily on the wide utilization of standard software components because the cost of software is 60 percent of the cost of ASU.

An analysis of algorithm and software shows that the solution of most problems may be reduced to a limited number of standard algorithmic and software modules to solve problems of gathering and reprocessing data, for the control of the technological processes and simulating control objects.

An algorithmic module is a complex of a pertinent, mathematical description of a particular scientific technological problem which originates when designing or implementing ASUTP [Automated System for Technological Process Control] functions formulated in a standard manner. The program module is a program realization of an algorithmic module, equipped with special data, sufficient to be grouped with other program modules into a single initial or execution program.

The use of algorithmic and program modules in designing the ASUTP makes it possible to obtain an essential economic effect due to grouping software for specific ASUTP from practically finished typical components, which facilitates the acceleration of the design process, increases the efficiency of designers' work and reduces the labor-intensiveness of creating the ASUTP.

For example, the creation in the Minpribor [Ministry of Instrument Making, Automation Equipment and Control Systems] of a general industrial program module library which is a single base of typical software components for the ASUTP in various industrial sectors and can be used to develop software with traditional, as well as automatic methods, made it possible to save over 800,000 rubles annually (without taking into account the increase in the quality of the ASUTP themselves and the acceleration of this introduction in production).

One characteristic form of ASU standardization is the use of typical solutions, systems of typical solutions and standard technical projects.

By a typical solution, we mean an individual progressive and promising solution of one of the scientific technological questions (or problems) by ASU software for manifold uses in various processes and productions in ASU developments.

The interrelated totality of typical solutions in the form of a documentation complex for multifold use in various ASU developments of a certain class for the execution of all data and control functions, common to ASU of the considered class, is a system of typical solutions.

A standard technical project is a problem oriented complex of typical and standard solutions for an ASU, that satisfies the requirements of a class of objects, spanned by the ASU, combined by the methodology of the project synthesis of specific ASU for a given class of objects.

The possibility of typicalizing ASU, in spite of a certain individuality inherent in each system, is dependent upon the use in practically any ASU typical solutions, i.e., typical methods and program solutions of control problems, typical technical control facilities, typical forms for the ASU introduction process, typical documentation, etc.

Table 1

(1) Стадии и этапы создания АСУ*	(2) Создание АСУ				(5) Источники экономии
	(3) при индивидуальной разработке (базовый вариант)		(4) с использованием типовых решений		
	продолжительность, годы	стоимость, тыс. руб	продолжительность, годы	стоимость, тыс. руб.	
(8) Стадия предварительных работ (организация разработки АСУ)	(6)	(7)	(6)	(7)	Проведение основных исследований при создании ТР (12)
Изучение состояния работ по созданию АСУ для аналогичных объектов в СССР и за рубежом	0,2	5	0,1	1,5	Использование типовых методов и форм проведения работ с учетом опыта индивидуальной разработки
Исследование базового объекта и существующей системы управления	0,3	20	0,3	3,0	Обработка и анализ исходных данных по установленным формам
(9) Итого	0 5	25	0,3	4,5	
(10) Стадии исследований и разработок (разработка ТЗ)					(13)
Исследование технологического процесса как объекта управления	0,5	15	0,3	2,0	Использование типовых методов и форм проведения работ с учетом опыта индивидуальной разработки
Анализ информационных потоков	0,5	5	0,3	2,5	Обработка и анализ исходных данных по установленным формам
Разработка предварительной математической модели производства	1,0	15	0,7	[illegible]	
Предварительный выбор методов синтеза алгоритмов контроля и управления	1,0	5	0,3	2,5	Использование типовых решений из библиотеки ТР
Предварительная разработка функционально-алгоритмической структуры системы	1,0	5	0,3	2,5	Сокращение затрат на оценку вариантов и разработку функционально-алгоритмической структуры системы
Предварительный выбор технических средств	1,0	5	0,3	2,5	Сокращение затрат на оценку вариантов
Предварительный синтез основных алгоритмов контроля, управления и функционирования	1,0	25	0,3	15,0	Использование алгоритмов из библиотеки ТР
Итого...	1,0	75	0,7	33,0	(14)
(11) Стадии проектирования: 1) разработка технического проекта					Возможность параллельного проектирования
Разработка постановок задач	1,3	20	0,5	15,0	Использование типовых методов и форм проведения работ с учетом опыта индивидуальной разработки
Разработка функциональной структурной схемы	1,0	10	0,3	7,5	Сокращение затрат на оценку вариантов и разработку структурной схемы
Разработка организационной структуры системы	1,0	10	0,3	7,5	Сокращение затрат на оценку вариантов и разработку организационной структуры системы
Разработка схем информационных потоков	1,0	10	0,3	7,5	Сокращение затрат на оценку вариантов и разработку схемы информационных потоков
Аппаратурно-технический синтез системы	1,3	20	0,5	12,0	Сокращение затрат на оценку вариантов и разработку схемы аппаратурно-технического синтеза системы
Разработка алгоритмов контроля, управления и функционирования АСУ	1,3	80	2,0	60,0	Использование алгоритмов из библиотеки ТР
Итого...	1,3	150	1,0	109,5	

Table 1 (continued on the next page)

Table 1 (continued)

(1) Стадии и этапы создания АСУ*	(2) Создание АСУ (3) при индивидуальной разработке (базовый вариант)		(4) с использованием типовых решений		(5) Источники экономии
	продолжительность, годы (6)	стоимость, тыс. руб. (7)	продолжительность, годы (6)	стоимость, тыс. руб. (7)	
(15) 2) разработка рабочего проекта					Возможность одностадийного проектирования (18)
Разработка рабочей документации на техническое обеспечение системы	2,0	100	1,0	60,0	Сокращение затрат на оценку вариантов и разработку схем
Составление заказных спецификаций					Применение типового оборудования, разработанного в рамках ТР
Рабочее программирование алгоритмов математического обеспечения	1,25	200	1,8	170,0	Использование программ из библиотеки ТР
Разработка эксплуатационной документации	0,75	30	0,3	4,5	Использование установленных и отработанных форм документов и макетов представления информации по опыту разработки индивидуальных систем Типизация процедур управления
Итого...	2,0	330	1,8	234,5	
(16) Стадия внедрения					(19)
Комплектация системы (приобретение и изготовление нестандартного оборудования, устройств и аппаратуры)	2,0	100	1,0	96.0	Сокращение затрат и сроков комплектации систем
Монтажные работы	1,0	40	1,0	36,0	Сокращение затрат и сроков монтажа оборудования
Наладочные работы	1.5	50	0.5	45,0	Сокращение затрат и сроков наладки оборудования
Отладка программ реализации алгоритмов контроля, управления и функционирования	2,0	100	1,5	84,0	Использование программ из библиотеки ТР
Опытная эксплуатация	0,5	20	0,5	18,0	Сокращение затрат за счет установления четких форм проведения опытной эксплуатации, учета данных по автономным и комплексным испытаниям и по опытной эксплуатации индивидуальных систем
(9) Итого...	2,0	310	1,5	279,0	
(17) Всего**	5,8	890	3,8	660,5	

(20) * Приведены стадии и этапы работ, по которым возможно сокращение продолжительности и стоимости при создании АСУ с использованием типовых решений.

(21) ** Общая продолжительность работ по созданию АСУ определена с учетом параллельности выполнения отдельных этапов работ.

Key to Table 1.

1 -- Stages in creating ASU*

2 -- Creation of ASU

3 -- Individual development (basic version)

4 -- Using typical solutions

Key to table 1 continued:

5 -- Sources of saving
6 -- Time, years
7 -- Cost, rubles
8 -- Preliminary work stage (organization of ASU development).
Study of state of the art on creating ASU for similar objects in the USSR and abroad.
Investigation of the basic object and the existing control system.
9 -- Total
10 -- Investigation and development stage.
Investigation of the technological process as a control object.
Analysis of data flows.
Development of preliminary mathematical production model.
Preliminary selection of synthesis methods for algorithmic monitoring and control.
Preliminary development of the functional-algorithmic structure of the system.
Preliminary selection of technical means.
Preliminary synthesis of basic algorithms for monitoring, control and functioning.
11 -- Design stage:
1) Development of technical project.
Development of problem formulation.
Development of functional structure arrangement.
Development of status of organizational system.
Development of data flow arrangements.
Apparatus-equipment synthesis of system.
Development of monitoring, control and functioning of ASU.
12 -- Execution of basic investigations in creating typical solutions (TR).
Use of typical methods and forms to carry out work, taking into account the experience in individual development.
Processing and analyzing initial data according to established forms.
13 -- Use of typical methods and forms for conducting work taking into account experience in individual development.
Processing and analyzing initial data according to established forms.
Use of typical solutions from TR library.
Reduction of costs for evaluating versions and development of functional-algorithmic structure of the system.
Reduction of costs for evaluating versions.
Use algorithms from TR library.
14 -- Possibility of single-stage design
Use typical methods and form of work taking into account experience in individual development.
Reduction of costs for evaluation of versions and development of the structural arrangement.
Reduction of costs for evaluation of versions and development of organizational structure of system.
Reduction of costs for evaluation of versions and development of data flows.
Reduction of costs for evaluating versions and developing an arrangement of the syntehsis of the apparatus-equipment system.
Use of algorithms from TR library.

15 -- 2) Development of the working project:
Development of working documentation for system software.
Preparation of customer specifications.
Working programing of algorithm software.
Development of operational documentation.
16 -- Introduction stage.
(Acquisition and manufacture of nonstandard equipment, devices and apparatus).
Installation work.
Adjusting work.
Debugging program algorithms for monitoring, controlling and functioning.
Experimental operationa.
17 -- Grand total**
18 -- Possibility of one stage design.
Cost reduction for evaluating versions and development of arrangements.
Use of typical equipment developed within the TR framework.
Use of programs from the TR library.
Use of established and debugged document forms and layouts for representing data in accordance with experience obtained in individual systems.
Standardized control procedure.
19 -- Cost and time for system equipment reduced.
Cost and time for installing equipment reduced.
Cost and time for adjusting equipment reduced.
Use of programs from TR library.
Cost reduction due to precise form for executing experimental operation, accounting for data on individual and comprehensive tests and experimental operation of individual systems.
20 -- *Stages of work are given which can reduce time and costs of creating ASU using typical solutions.
21 -- **Grand total time for creating ASU is determined taking into account parallel execution of individual work stages.

The technical economic analysis, made by the Central Scientific Research Comprehensive Automation Institute [TsNIIKA] when creating ASU in various industrial sectors, indicates that in using typical solutions, the grand total of development time is reduced by 40 percent and the cost by 20 percent as compared to individual development. The economic effectiveness of creating ASU using typical solutions is due to a reduction in the time and costs at all stages of ASU development.

Thus, in the design stage, this is achieved by a reduction in the volume of work on technical and working design, a reduction in the number of design material corrections, reduction of design stages, etc., i.e., it may be possible to use one-stage designing.

The change from a one-time manufacturing of individual units to the use of universl units, from which a "typical" system is selected, makes it possible to reduce the costs of nonstandard equipment and accessories.

The use of the data of results of tests and experimental operation of individual systems, an analysis of the technical economic, operational, reliability and other characteristics, as well as the determination of clear-cut forms

for operational experimental ASU will make it possible to reduce the time and cost of this stage.

In economic evaluation, it is necessary to take into account the direct reduction in the cost of creating the ASU, as well as the reduction in the time of introduction in production and the saving obtained during the entire period of development and introduction of the system.

All one-time investments, related to the implementation of the development and introduction process of ASU, are excluded from the process of production utilization and do not produce returns as in the case of fixed operating capital. The shorter the period of "freezing" one-time investments, the sooner they produce corresponding returns. Therefore, the development time has a direct effect on the ASU efficiency and must be evaluated taking into account an average norm of the effect that could have been obtained by the productive utilization of capital investments for the creation of the given system.

The annual economic effect of creating the ASU using typical solutions (TR), systems of typical solutions (STR) and standard technical projects (UTP) can be calculated by formula:

$$\begin{aligned}Э_{TP} = E_{н.в.т}\{[&K_1'(1+E)^{T'-1} + K_2'(1+E)^{T'-2} + \dots + K_{T'-1}'(1+E) + K_{T'}'] - \\ -[&K_1''(1+E)^{T''-1} + K_2''(1+E)^{T''-2} + \dots + K_{T''-1}''(1+E) + K_{T''}''] - З_{TP}/B\}n,\end{aligned}$$

where K_1', K_2', ..., $K_{T'}'$ are costs in a corresponding year of developing and introducing individually developed ASU, in 1000 rubles; K_1'', K_2'', ..., $K_{T''}''$ are costs in a corresponding year of developing and introducing ASU using TR (STR, TUP), in 1000 rubles.

T' and T'' are times for creating and introducing correspondingly original solutions and TR (STR, UTP) ASU, in years;

$З_{TR}$ are costs of developing TR (STR, UTP), in 1000 rubles;
B is number of ASU planned for the estimated, period, created by using TR (STR, UTP) systems;

n is average number of ASU created annually using TR (STR, UTP) systems;
E is the norm coefficient for reducing one-time costs;
$E_{H.B.T}$ is the normal coefficient of the efficiency of capital investments in creating ASU and introducing computers.

Table 2

(1) Год осуществления единовременных затрат	(2) Создание АСУ (3) при индивидуальной разработке (базовый вариант) (5) номинальные единовременные затраты, тыс. руб.	(6) коэффициент приведения	(7) приведенные единовременные затраты, тыс. руб.	(4) с использованием типовых решений номинальные единовременные затраты, тыс. руб.	(6) коэффициент приведения	(7) приведенные единовременные затраты, тыс. руб.
(8) Первый	40,0	1,6105	64,4	140,0	1,3310	186,3
Второй (9)	130,0	1,4641	190,3	180,0	1,2100	217,8
(10) Третий	170,0	1,3310	226,3	190,0	1,1000	209,0
Четвертый (11)	185,0	1,2100	223,8	150,5	1,0000	150,5
(12) Пятый	185,0	1,1000	203,5	—	—	—
Шестой (13)	180,0	1,0000	180,0	—	—	—
(14) Итого	890,0	—	1088,3	660,5	—	763,6

Key to Table 2.

1. Year of spending one-time costs
2. ASU development
3. Individual development (basic version)
4. Using typical solutions
5. Nominal one-time costs, 1000 rubles
6. Reduction coefficient
7. Reduced one-time costs
8. First
9. Second
10. Third
11. Fourth
12. Fifth
13. Sixth
14. Total

We will show on the example of developing a typical "Kaskad-TM" ASU how the economic efficiency of such systems can be calculated on the basis of the described principles. The system is developed on the basis of correlating the experience of developing several individual ASU in the chemical and petrochemical industries taking into account the common nature of the problems being solved and their characteristic criteria and features. The "Kaskad-TM" system of typical solutions includes a totality of standardized technical facilities and software.

The "Kaskad-TM" system uses a series manufactured computer, standard communications devices and other standard devices.

"Kaskad-TM" software is a set of algorithmic and programing means used in the software synthesis of specific systems and includes the following: a library

of program modules (primary data processing, calculation indicators, parameter evaluation of the object model); a set of programs for the automatic design of algorithmic software, which selects the structure and parameters of primary processing algorithms, calculates parameters and makes it possible to automate a significant part of the work on software; the means for automated synthesis of ASU programs using library modules.

Methodological facilities of the "Kaskad-TM" ASU are designed for use by research and design organizations in creating specific systems and include the following methods that simplify and make it considerably less expensive to create the ASU in the following stages; preliminary investigation; functional synthesis; software generation.

A "Kaskad-TM" ASU was developed and functions successfully in a number control systems for nitrogen fertilizer and chlorine production facilities, as well as in production of mineral fertilizers and acids.

Table 1 shows comparative data on the time and cost of creating ASU in individual development and when using typical solutions of the "Kaskad-TM." It may be seen from the table that the cost of developing and introducing ASU when using typical solutions, as compared to individual development, was reduced by 229,500 rubles. The development and introduction times of the system also decreased.

Table 2 shows the distribution of once-only costs for ASU individually developed and when using typical solutions. In the five-year plan period, it is planned to produce ten similar ASU using typical solutions, an average of two systems a year. Once-only costs for developing typical solutions were 520,000 rubles. The annual saving was 183,900 rubles.

The proposed approach makes it possible to establish the economic soundness of using typical solutions in creating ASU and plan volumes and priorities of the systems.

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